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THE LAGUNA DE SANTA ROSA: A CLASS
STUDY PROJECT, THE BIOLOGICAL ENVI
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The Laguna de Santa Rosa



A Class Study Project

The Biological Environment

ENSP 321

Spring Semester 1989

Directed by

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Foreward

My students have studied the Laguna de Santa Rosa for the past two semesters. It is ideal for the study of the environment, standing as it does at the crossroads of conflict: growth vs. preservation; regional water management; agriculture and more. While the debate about the future of this second largest freshwater wetland in Northern California goes on, it is well to remember that the Laguna itself is not on hold. It daily becomes less in terms of water quality, wildlife habitat, flood storage capacity and community resource.

These student papers are a snapshot of what crosses a teacher's desk. They are replete with typos, errors of fact in some cases, and unabashed enthusiasm for the environment. It was never intended that their reports would become part of the citable literature. However, it is hoped that their ideas will provide food for thought in the on-going public discourse.

Many of the students were new to Sonoma County. Some are just beginning their professional preparation while others are poised to graduate and seek their first job. With enthusiasm, they set out to learn first hand about the Laguna from local experts in government and in the environmental community. You who so unstintingly gave your time and knowledge are to be commended for enriching the educational experience. There is no substitute for a "real world" contact to enhance the "ivory tower." More of you came to be our audience as we polished our public speaking skills. I thank you all and add my own particular appreciation to Bob Sharp, U.S. Fish and Wildlife Service, retired, and Bosco Advisory Committee member, Bob Klampt, North Coast Regional Water Quality Control Board and Arnold Jensen, Llano Wastewater Treatment Facility for leading us on field trips and to Bill Cox, California Department of Fish and Game for a presentation about the Laguna.

The student reports open with philosophical observations that the Laguna issues are a microcosm of the global environmental issues of our day (Peterson, p. 1). One issue is whether the Laguna should become a formally designated Wildlife Refuge. The proposed legislation is tortuous, at best, and will require dedicated advocacy over a long period to see it through (Dabkowski,p.15). Whether or not this wetland becomes a refuge, it seems likely to be subject to more environmental protection under the provisions of the Clean Water Act, Public law 100-653(Northcutt, p.169), The Native Plant Protection Act, The California Endangered Species Act, and The California Environmental Quality Act(Gardner,p. 115).

The effect of growth on the land uses around the Laguna is the driving force for change in the region (Rodriquez,p. 27). In this regard, a most central issue is the future role of agriculture. Mellersh(p. 55) and Chavez(p.38) explored the impacts of pesticide use and manure upon the water quality of the Laguna. March(p.63) compared the most used agriculture preservation methods applicable to Sonoma County and the Laguna. Avila(p.77) conducted in-depth interviews with the local farmers to learn first hand about these stake-holders in the Laguna's future. She concluded that."Agriculture must have input into the development of a plan for a sucessful refuge. The co-existence(of agriculture) is dependent on joint efforts."

Two students had a Tom Sawyer and Huck Finn experience canoeing in the Laguna(Ibach p. 148, Hildebidle p.136). It underscores the issue of access. They were alternately thrilled by the majestic glides of Great Blue Herrons and the uncommon sight of a river otter and appalled by the evident pollution which assailed their eyes with rusting oil barrels and the rainbow sheen of floating oil and their noses with the aroma of petroleum vapors and a dead raccoon. The incident was reported to the authorities and suggests that lack of access invites pollution when there are no eyes to see the polluters in action. On the other hand, Lewis(p.89) drew upon his experience as a seasonal Ranger in an Alaska Wildlife Refuge to suggest that wildlife restoration would require some restriction on access to give the living world a change to mend.

Restoration occupied the energies of several students(Francisco p. 106, Gardner p. 115, Hildebidle p.136, Ibach p. 148, Northcutt p. 169) and they offered many practical suggestions such as, beginning with communities or species most likely to respond to restoration efforts. The "Circuit Rider" approach of using seeds and cuttings from the local area for restoration stock was advocated.

At our oral presentations, Brenda Adelman aptly observed, "When you have solved a problem in one area you often have just pushed it somewhere else." This is certainly true of flood plane management which we understand better as result of Lindbeck's(p. 176) article and appreciate in Huggin's(p. 188) thought that letting some channels become more natural in the Laguna would alter events upstream. Another example might be roads. They hold the potential for access and at the same time divide the proposed refuge in such a way as to potentially turn gene pools of indigeous biota into puddles in the "Island Effect"(Nagel,).

Plikuhn(p.206) has examined the chemical/energy intensive way in which waste water is treated. He suggests that smaller communities may wish to follow an alternative(and less costly) path to biological sewage treatment and, perhaps, the smaller communities now using the large regional facility may want to explore disconnecting in the future by using this approach.

Use of reclaimed water can substitute for water which might have been pumped from groundwater sources. The very significant draw down of the wells at Sonoma State University may serve as the "Canary in the Mine" to other communities on the Santa Rosa Plain that we may be overdrafting the ground water resource(Rose, p. 216). It is estimated that half the pollution in San Francisco Bay comes from non-point sources. As Christopher(p. 226) points out, it is the most neglected aspect of water quality in the Laguna. When the first rains of the season came, my class and I were shocked to see the oily murky water from the SSU parking lots running into Copeland Creek, to the Laguna, to the Russian River, past the point where our drinking water is drawn and on into the Pacific. I resolve to work with the Campus community to become a model in controlling non-point water pollution.

Clearly the University best serves the development of the life of the mind by encouraging independent thought. Neither my students nor I agree with one another about all the particulars in these reports. It was, then, with some soul searching, that I deleted a paragraph from David Berg's(p.235) report on the media. David interviewed a public servant and quoted him, accurately I think. In a judgment call I deleted it from the report since it was potentially sensitive and I could not verify whether the speaker knew he was "on record."

With an eye to the future, two students(Brunnellep. 239 and Reeves p. 245) developed an extensive compendium of educational materials suitable for elementary school students which focus on the Laguna. These should be an excellent community resource for teachers.

I close with gratitude to my students. Even though we live in the close of the "Now Generation" era, they constantly teach me the powerful importance of the future and of the moral and ethical responsibility we have to posterity.

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June 1, 1989

THE LAGUNA DE SANTA ROSA
SPECIAL REPORT

by
Rosalind Peterson

The Biological Environment
May 18, 1989
Dr. Jean Merriman

INTRODUCTION

My knowledge of the Laguna de Santa Rosa was very limited before taking Dr. Jean Merriman's Biological Environment Class this spring. Since I live in Mendocino County I am much more sensitive to environmental issues there. Thus, the introduction of the Laguna in this class has broadened my knowledge of this area.

The Laguna de Santa Rosa is a very diverse area. It is a river, a flood plain, a wetland, a marsh and a wildlife habitat which is very important to Sonoma County. It is the second largest freshwater marsh in Northern California.(1) It extends approximately 14 miles from Cotati and Rohnert Park north to the Russian River.(2) Its watershed comprises approximately 160,000 acres of land. A part of this area, about 7,000 acres, also acts as a flood basin which has a water storage capacity of 80,000 acre feet.(3) This storage basin is critical in times of flooding to protect downstream communities such as Guerneville.

The Laguna also provides an area for wastewater disposal, agricultural uses, flood drainage from surrounding areas and wildlife habitat. Plants, vernal pools, reptiles, amphibians, fish, flora and fauna can also be found in the Laguna. Some of these plants and animals are on the endangered list or are not found anywhere else in the world.

Riparian forest zones have long been recognized as having the richest areas of wildlife habitat in California, both in numbers and diversity.(4) Unfortunately, the majority of wetlands have been damaged or destroyed. However, there are many areas in the Laguna which do support wildlife habitat or that could be restored so that it would support such life again.
(5)

In class we were provided with some first hand experience with the Laguna through field trips and slide lectures. These provided a visual basis to understanding both the positive and negative aspects of human development on the area. The Laguna is a wonderful laboratory for observation, experimentation and study. It is a library for geology, ecology, archaeology, hydrology, vegetation and wildlife, which many people can use.

This class has taught me that the Laguna is a great benefit to the community in a variety of ways. It does need our protection which could be provided by having the area declared a National Wildlife Refuge. If the

land is allowed to be unwisely developed, the functions which are now performed by nature would have to be replaced with expensive, often fuel-consuming, technological substitutes. If a flood plain is subdivided for homes, then flood control dams, channels, and storage basins must be constructed. When natural areas are destroyed, man-made parks must substitute for natural recreation areas. The unwise destruction of natural drainage and vegetation and the additional facilities which result, represent a huge and unnecessary expense to taxpayers.

The Laguna has been the subject of many studies. More are being planned for the future. These studies are necessary in order to protect and restore the Laguna so that it keeps working for the benefit of the entire community. These studies also raise many unanswered questions. Some of these questions have become the basis of the following report.

THE PROBLEMS

Man has been treating the environment as if there were no tomorrow-- as if there would be no new generations to be sustained by the bounties of the earth. Future generations, as well as ourselves, have to drink the water and breathe the air. We are all vulnerable to deadly waste, ultraviolet light and climatic disasters. When governments, their agencies, corporations and others permit chemical pollution, destruction of forests, unlimited growth, and species extinction, all in the name of greed, they are a threat to our security.

The Laguna de Santa Rosa has survived man's destructive tendencies to date. The question of whether it can continue to survive requires our immediate attention. It has already been damaged severely by farming, urban sprawl and the demands of a growing population.

Escalating population is creating additional and more serious burdens on the Laguna each year. The problems come from a variety of of sources: (6)

1. Agricultural Chemicals & Fertilizers.
2. Industrial Pollution
3. Automobile Pollution
4. Waste Dumps
5. Treated Wastewater

The above list is incomplete as there are many other sources of pollution in Sonoma County. These include: (1) Logging, (2) Overgrazing, (3) Poor Farming Practices, (4) Poorly Maintained Septic Systems, (5) Illegal Dumping of Toxics, and (6) Other Sources of Point & Non-point pollution. In addition there are four main areas of concern which should be studied more fully:

1. POPULATION GROWTH
2. RIPARIAN FORESTS
3. ANIMAL WASTE
4. TOXIC CHEMICALS

Since many of the other important concerns are being addressed at this time to some extent, it is important to look closely at these four areas. These four problems need to be fully researched because of their importance to the community and the Laguna de Santa Rosa.

POPULATION GROWTH

A growing local and world population, making increasing demands on the environment, is beginning to take its toll on the land. Greed and short-term profits, in many cases, are escalating environmental degradation and pollution. In Sonoma County increased population is pushing local cities and the county to expand land use. This expansion is away from open space, farming, riparian areas and toward expanded land use for housing and roads.

Land use planning is now becoming a large issue for many different cities and counties. The Sonoma County General Plan, adopted on March 23, 1989, is an example of these demands. The plan is very general in nature and tries to project existing trends into the future. It is reacting to crisis situations created by urban development.

The plan is not going to be effective in the future because it promotes a continuation of our inefficient use of resources. It is not only trying to react to pressures but in the process it is trying to deal with all of the special interest needs, each wanting their share. If this plan used an ecological approach the whole community would benefit in the future.

Instead of planning to deal with existing cities, revitalizing housing projects, designing growth to make use of mass transit, trains, and bicycles, the plan encourages more single family dwellings, more roads and more general highway expansion. These are existing trends. It would be easier to build more compact population centers which would occupy relatively small areas and have higher population densities. This would reduce heating and cooling costs, be more energy efficient, require fewer roads and leave more flat land for agricultural use, riparian habitat and open space. With a more centralized growth pattern the resources of the community could be used more efficiently with less demand on areas outside the community for food production, water and wastewater disposal.

The Sonoma County Plan does not research these issues. If we are to meet the demands of an already overloaded system, we must look at the future and work back to the present from that perspective. Only in stepping away from immediate problems and looking at them from a future ecological perspective can man take the steps necessary to avoid

an environmental crisis. The ultimate stress on our environment will be felt first by the Laguna de Santa Rosa.

RIPARIAN FORESTS

How important is riparian habitat? The value of riparian forests has been understood by a few people for a very long time. It is only now being understood by the public because of increased education and knowledge of this subject.

Even in our own local areas the continued depletion of our forests threatens to destabilize this county. It could begin by generating a slow climate change, both directly by effects on the hydrological cycle and atmospheric circulation patterns, and indirectly, by contributing to the atmospheric carbon dioxide burden. The effects may not be felt in dramatic ways at first but would begin to be felt as more and more destruction occurs.

Riparian forests are of vital importance to all watershed systems in the world. Without these forests vital interrelated systems would collapse and create additional problems for both man and animals. Without forests, there is increased sedimentation buildup, flooding, overloaded storm drains in cities, serious soil erosion, water pollution, little recharging of underground water supplies, loss of habitat for wildlife and fish, loss of riverbank stability and degraded water quality.

When man alters these systems, expensive and artificial solutions have to be constructed. When land is developed, as has been near the Laguna, it leads to waterways being straightened and channelized, paved channel construction, and in many cases waterways which are erased completely. This leads to faster water run-off, little or non-existent groundwater replenishment and increased flooding in heavy rains. When flooding occurs there is increased public pressure to build more culverts, more cement channels, and more dams to prevent flooding. In most cases this type of construction just causes more problems for those living downstream.

We have the knowledge, expertise and ability to identify these watershed areas and prevent their destruction. This would decrease the need for artificial answers. The cost may be reduced by proper planning or negated completely. The results of good planning could lead to:

1. Helping to restore the Laguna.
2. Improved water quality in the Laguna.
3. Increasing wildlife in the area.
4. Reduced Flooding Patterns.
5. Groundwater recharging.
6. Less demand on wastewater treatment facilities.
7. Less demand on outside water resources.

There are many and varied reasons for preserving riparian forests in Sonoma County. Just to provide a home for wildlife in an otherwise highly developed and paved landscape is important. Trees are also a necessity for a healthy aquatic system as well. They provide a home for fish, keep water temperatures cooler, act as a way for food to reach the fish from insects which fall into the water from overhang along the banks, and provide shelter for animals or birds which provide insect control.

Water and air quality are also affected by trees. Forests filter and remove pollutants from the air. One acre of trees, for example, can remove 3.7 tons of sulfur dioxide and 12.9 tons of dust per year.(7) They also support soils which readily absorb rainfall. This water is then percolated into the groundwater and streams, replenishing them.

ANIMAL WASTE

The third most important problem directly facing the Laguna de Santa Rosa is animal waste from dairy farms. This problem is costly because of stream degradation and the degradation of the rich terrestrial ecosystems that border them.

Most lush vegetation is located within a few yards of the waterways. Naturally, cattle congregate there, trampling the vegetation, beating down stream banks, and defecating and urinating near or directly into streams. The resultant load of eroded soil and wastes, combined with increased stream temperatures because of lack of shading, reduces or exterminates certain types of fish population and degrades the water.

On one of the class field trips, Bob Klampt, an Environmental Specialist for the North Coast Regional Water Quality Control Board, was asked about water quality in the Laguna. "Depends," he said, "...in some areas it is absolutely horrible from dairy farm manure run-off." He went on to say that when this manure cooks all summer,

in the sun. It can create a toxic ammonia filled environment. There have been fish kills from this problem in the past. When organic matter decomposes in stream beds the water loses oxygen as well. Thus, Mr. Klampt felt that the problem of dairy manure needed to be addressed in the future in order to restore water quality and the native fish populations which no longer live in the Laguna.

Cattle also reduce the water-retaining capacity of riparian (stream bank) ecosystems, making both floods and droughts more likely. Aesthetic and recreational values are also compromised, as camp sites become wall-to-wall cow pads and fish populations are reduced. Tree seedlings are also eaten or trampled by cattle leaving only an older tree population along the banks. This means that there is no renewal of a forest which is growing older and dying.

Another source of pollution in the Laguna is from barn washings. The barns where dairy cattle are milked are washed each day. Manure and water mix and are collected in ponds. This mixture is then pumped onto fields and acts as fertilizer. This is a very energy intensive system. It is not only costly for the farmer but requires constant repair and supervision. It is easy for ponds to overflow into the Laguna or be left in disrepair so that water cannot be efficiently pumped onto nearby fields. These ponds need to be more widely regulated and additional ways to handle manure needs to be found.

TOXIC CHEMICALS

The last, and possible most incidious problem, facing man is the threat from toxic chemical pollution. It may come from factories as air or water pollution, from agricultural chemicals used in pest control, from city or county weed control projects, from golf courses, waste dumps, home usage, improper disposal and a variety of other sources.

Water gives life to the earth. But his most elemental offering of nature to man now carries a threat. There are people drinking water that is contaminated and in many cases they don't even know it. A flood of chemicals has invaded America's drinking water. Chemicals known to cause birth defects, nerve damage, cancer and other problems.

Man-made chemicals have been poisoning our surface water, the water which is visible. Now, many of those same chemicals have filtered into

the vast hidden stores of water held in the ground under us; ground-water from which roughly half of the population of the United States drinks. These are poisons that may stay captured there for generations, collecting in concentrations thousands of times greater than in surface water, to move unseen slowly in great plumes to wells across the country.

Regional reports of the Environmental Protection Agency identify serious groundwater contamination in 34 states. There are more than 25 states where serious contamination has led to the closing of drinking wells. California is one of those states.(9)

The frightening aspect is that very little is known about these problems. It is usually discovered only when people begin showing health effects from contamination. We have become the main detection system for these chemicals.

The explosion of new chemicals since World War II, over 63,000, has brought great benefits.(10) But now it is exacting an ominous price. Communities with drinking water contaminated by chemicals are being hit with strange patterns of illnesses. But little research is being done to determine which communities are in danger. Less research is being done on what these chemicals are doing to man. There is no effective system to monitor groundwater nationally much less locally. Enforcement of existing laws to protect water, are in many cases, neglected.

In 1973, Congress passed the Safe Drinking Water Act and directed the Environmental Protection Agency to enforce it. There have been over 700 chemicals found in drinking water.(11) The EPA has targeted 129 as posing the greatest threat in water, but to this date the EPA requires that our drinking water be tested for only 14 of those 129.(12)

Nationwide, one of the major sources of groundwater contamination comes from pesticides and herbicides used on farmland. California's Central Valley, 7,000 square miles from Lodi to Bakersfield, is an area that has the largest known case of groundwater contamination in the country.(13) There are 35,000, possibly more, registered pesticides which contain 600 compounds in use.(14) The EPA requires tests for only 6 in our drinking water sources.(15) Many of these chemicals will remain in groundwater for generations.

Many of these toxic chemicals, possibly as high as 80%, have not been tested adequately according to EPA standards for their capacity to cause cancer, birth defects and genetic mutations.(16) What are the

consequences of toxic chemical usage? How much is being used in Sonoma County? Do we know the full extent of the danger these chemicals pose to us and our environment? And who, is protecting us?

Through increased use of toxic chemicals on our agricultural land, our water, our animals, and our food and soil is becoming contaminated. The pests which these chemicals are designed to destroy are becoming more resistant to these chemicals. In order to control this more resistant generation of pests more highly toxic chemicals are being introduced into our environment. In the process we are losing beneficial plants and animals.

Mendocino County, like Sonoma County, uses many chemicals which are restricted for use. According to the California State Department of Food and Agriculture's monthly pesticide use report for Mendocino County, dated April 1988, over 4,000 acres of land were treated with 13,346.38 pounds of restricted chemicals.(17) Eight were applied to apples, seventeen were used in landscape maintenance, six were used on grapes, seventeen were used on rights-of-way, two were used on non-agricultural areas, four were used on pasture/rangeland, five were used on pears, fourteen were used in structural pest control, and one was used for vertebrate control. These totals do not include non-restricted chemicals which can be purchased by the public at grocery stores, hardware stores, farm supply houses and variety stores.

There are nearly 50 chemicals listed in the above chemical usage report. According to the State Department of Food and Agriculture, their Pesticide Registration and Evaluation Committee is reviewing 13 of these chemicals because they have been identified as having potential adverse health effects in studies of sufficient quality to permit a risk assessment. Eleven of the thirteen chemicals are listed in the high priority group based on the number of potential adverse effects, the nature of potential adverse effects, the number of species which may be affected and potential human exposure.

Under California's Proposition 65, the following chemicals, used now in Mendocino and Sonoma Counties, have been identified as having potential problems:(18)

Amitrole	Known Carcinogen
2,4-Dinitrophenol	Probable Carcinogen
Chlordane	Probable Carcinogen

The California State Department of Food and Agriculture is reviewing the following chemicals used in most counties including both Sonoma and Mendocino counties because earlier studies have indicated that there were adverse effects:(19)

Amitrole	Oncogenicity study, teratology study, Mutagenicity study
2,4-D	Combined oncogenicity/chronic toxicity study Reproduction study
Diquat	Combined oncogenicity/chronic toxicity study, Mutagenicity Study
Paraquat	Mutagenicity study, combined oncogenicity/chronic toxicity study, chronic toxicity study, Oncogenicity study
Chlordane	Mutagenicity study, oncogenicity study
Lindane	Mutagenicity study
Simazine	Combined oncogenicity/chronic toxicity study
Dicamba	Neurotoxicity study, mutagenicity study
Glyphosate	Oncogenicity Study.
Diruon	Mutagenicity Study
Oxadiazon	Chronic toxicity study, oncogenicity study Mutagenicity study
Chlorpyrifos	Mutagenicity Study
Propoxur	Chronic Toxicity Study, Combined oncogenicity/ chronic toxicity study

In 1988, Ukiah's drinking water at the tap was tested for some of these chemicals plus several which had been banned for several years. Traces of Lindane, 2,4,5TP and Silvex, 2,4-D, Endrin, Toxaphene and Methoxychlor were found. This is the same drinking water which is shipped from Lake Mendocino to Sonoma County residents for drinking purposes. There are so many chemicals in use in each county, the cost of testing water for each one is enormous, and therefore, many of these chemicals pass through the system without being detected. Powdered activated carbon can be used to remove some of these chemicals depending on their formulations. It is costly, not used in Sonoma's wastewater treatment plant or in their normal drinking water processing because of cost. Since testing requires time many chemicals are already through the treatment plants before it is known that they are there and preventitive measures can be taken.

These pollutants and many others are heading toward the Laguan de Santa Rosa. Agricultural run-off is one major source of chemical pollution. Enormous amounts of chemicals are sprayed annually in

each of California's counties. Combined with other sources of pollution this is amounting to a tremendous threat to our community.

CONCLUSION

The Laguna de Santa Rosa is a microcosm of the problems which are happening all over the world. This small area is of invaluable importance to Sonoma County in a variety of ways. The problems facing the Laguna from overpopulation are many. This population will continue to have adverse effects until more ecologically sound principles are adopted.

It is very easy to point a finger at other areas of the world and give advice to them. We want to protect South American Rain Forests and wild animals in Africa. They are distant places and what happens in those areas have some effect on the entire world. And yet, it shows greater courage to take a controversial area closer to home and try and protect it. It takes a dedication of time, money, and hard work to make those changes. It is necessary, not only to protect our own environmental ecosystems, but to set an example that the rest of the nation and world can follow.

We owe a great debt to those who have dedicated themselves to this cause. They inspire us and help us to understand the value of the treasures which surround us and are necessary to the survival of future generations. We must take a stand now to preserve for posterity those things which we use and take for granted.

We need leaders, from the President of the United States to our local city council, who do not confirm our cherished illusions and cater to our prejudices and insecurities. We need leaders who will tell us the truth, however painful, and who will trust the people with the truth. We need courageous, ethical, and moral ways of acting and dealing with our treasurers. We can no longer afford the luxury of greed and excessive profits. We must also realize that the technological "fixes" may not work. It is an interrelated society which we live in today. Prevention and future planning must be our goals. The future is at stake.

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**A Bit of Wildlife refuge's
Legislative History and its effects on the
Laguna de Santa Rosa
by Laurie Dabkoski**

Dr. Merriman P.H.D.

Fannie Babkoski

***A bit of Wildlife
refuge's legislative History and
its effects on the Laguna de Santa Rosa***

If the Laguna de Santa Rosa is designated as National wildlife refuge (WLR) it will become one of more than 400 existing refuges that span the continental United States, as well as Hawaii, Alaska and several U.S. territories. In all, these areas encompass more than 90 million acres of prime wildlife habitat. 1 These managed harbors for wildlife didn't come into being over night, rather they evolved from a long and often tedious process throughout this century. For over 80 years a sucession of laws have been passed to ensure the protection of wildlife; it is this legal historial perspective and its effects on the Laguna de Santa Rosa that will be discussed.

When the first Europeans came to North America, wildlife was prolific. The indigenous people of North America had a strong sense of land stewardship and practiced subsistence hunting, gathering and small scale sustainable agriculture, this allowed other creatures to co-exist among them in great numbers.

This balance between humanity and nature started to totter seriously out of equilibrium as the new world was settled by Europeans. The new settlers greatly altered the North American wildlands by felling forests, farming prairies, dyking wetlands and hunting excessively.

By the 20th century much of the U.S.'s remaining wildlife were remnants of once great numbers. Many Americans had come to realize that wildlife, especially big game and waterfowl, were in danger because of these excessive human activities. During the early 1900's, the federal government had set up The Bureau of Biological Survey to try and cope with some of these problems, but it was ineffective, as it was operating within the Department of Agriculture which was primarily concerned with wildlife's relationship to agriculture. 2

Fortunately, this increased awareness was also the impetus for the formation of many citizen's environmental groups like The Sierra Club and Audubon Society. These groups were more effective in combating wildlife and habitat losses because of fewer bureaucratic influences. 3

It was the outcry from these organizations and the environmental concern of President Roosevelt that served as the stimulus for the establishment of the first WLR at Pelican Island, Florida. The Pelican island refuge was set up as a bird sanctuary, so that the remnant

populations of brown pelicans, herons and egrets might have a safe nesting ground far away from the bullets of avarious plume hunters, that threatened to reduce these bird's numbers still further. 4

Additional areas were reserved by Congress from federally-held lands into the WLR system. Included was The Wichita Mountain Wildlife refuge. This forest was designated two years after Congress had considered turning the entire forest reserves, now known as The National Forests, into game reserves. These reserves would have been closed to the taking of all wildlife that lived within them. This consideration never came to pass, but it helped pave the way for the seven additional game preserves that were added to the WLR system between 1904-1914. 5

It was not until 1924 that Congress authorized the first purchase of private land for incorporation into the refuge system. This addition of the Upper Mississippi River Wildlife and Fish Refuge, a major waterfowl production area, was unique because it was the first time private land was purchased specifically for inclusion into the refuge system. Previously, only already federally-held lands were incorporated into the WLR system; these areas were not always a significant addition into the WLR system, because they were not as ecologically vital, as these private lands, incorporated later.

This important waterfowl production area incorporation and, many other wetlands that were later designated into the WLR system, were prompted by the passage of The Migratory Bird Treaty Act of 1918 and The Migratory Bird Conservation Act of 1929. The treaty of 1918, an agreement between the U.S., Mexico, Japan and Great Britain, (acting for Canada), provided federal responsibility for the welfare of Migratory waterfowl. It also set up regulations controlling the:

*....taking, possession, selling, transportation
and importation of migratory birds. 6*

Although the Migratory Bird Treaty acknowledged Federal responsibility for migrating waterfowl, it did nothing to initiate the acquisition of suitable habitat. 7 This short coming in the law was eventually compensated for in 1929 when ,after eight years of lobbying, conservationists persuaded Congress to enact The Migratory Bird Conservation Act. This act set up a commisssion that recommended necessary habitat to be purchased and/or rented at a price set by the committee to ensure the perservation of these migrating birds. The Commission fixed the price at which the land could be rented or purchased. This act was instrumental in researching and pricing suitable habitat for migratory waterfowl, but Congress did little to provide funds for land

acquisition. 8

The funding weakness in the Migratory Bird Conservation Act, a drought in the Great Plains, and extensive dyking and draining of wetlands for farm improvements, combined to severely reduce and degrade existing marsh lands in the mid-west. Fortunately, environmentalists, supported by the conservation minded administration of Franklin D. Roosevelt, once again pressured Congress to act. 9 Congress responded with The Migratory Bird Hunting Stamp act of 1934 which required that all waterfowl hunters, sixteen and older, purchase and possess a valid "duck stamp," before they would be allowed to hunt. The cost of the first "duck stamps" were one dollar. 90% of these earned tax revenues were used by the Secretary of the Interior to locate and purchase areas suitable for migratory bird refuges and waterfowl production. 10

Within the same year the Stamp act was passed, Congress enacted the Fish and Wildlife Coordination Act of 1934. This law authorized the acquisition of land for fish and wildlife to help conserve life forms impacted by water diversion projects, then being taken on at an accelerated pace by other federal agencies. 11

Shortly after the Fish and Wildlife Coordination Act of 1934, the Bureau of Biological Survey was transferred to the Department of the

Interior and consolidated with the Bureau of Fisheries. The two agencies were then renamed into one cohesive agency, The U.S. Fish and Wildlife Service. Separated from the Department of Agriculture, the service was better suited to act in the sole interest of wildlife. 12

Although the Bureau of Biological Survey had been reorganized, designation of Wildlife refuges continued by executive order between 1936 and 1939, when President Roosevelt created 5 refuges by purchasing private lands in Arizona, Nevada and Montana. These lands, unlike the majority of the previous waterfowl refuges, served as reserves for larger grazing animals. 13

Acquisition of private lands, from the general revenue coffers continued under several congressionally mandated acts, including the Lea Act of 1948, which authorized the purchase of land to be used for the establishment of refuges within California. The Fish and Wildlife Act (FWA) of 1956, created an unequivocal wildlife protection policy for the new department of U.S. Fish and Wildlife service. Its new role included the management and conservation of existing wildlife refuges and the "research" and acquirement of new lands that could be included into the WLR system. 13 In addition to the FWA, the Endangered Species Act (ESA) of 1970, also funded by general revenues, provided the U.S. Fish and

Wildlife with land acquisition monies to conserve species endangered with extinction. 14

In addition to these three acts, the Lea act, the ESA and the FWA, Congress supported WLF establishment by enacting the Land and Water Conservation act which bolstered the U.S. Fish and Wildlife Service's funding basis by allotting offshore oil and gas revenues for further refuge acquisition. 15

Equally as important as the Land and Water Conservation act (LWCA) was The Small Wetlands Loan act of 1970. This law allowed the U.S. Fish and Wildlife service to borrow against duck stamp revenues, for the purpose of accelerating the purchase of waterfowl habitat. 15

All these legislative acts were part of a crucial effort to fund the incorporation of private lands into the WLR system. Today the Federal government has a few ways in which it utilizes these funds to establish WLR. One of the most frequent establishment methods has been designation by the Secretary of Interior, acting on recommendations from the U.S. Department of Fish and Wildlife. This method is the most common, in fact about 80% of all existing refuges have been established in this manner. Sadly, over the last eight years many of theses acts, designed to fund WLR from general revenues, have been cut and or

enormously scaled down. For instance, recommended appropriations for the Land, Water and Conservation Act during the Reagan administration was nil ! This irresponsible recommendation was never fully approved by Congress. But these recommended budget fiascos have forced the U.S. Fish and Wildlife Service to cut, and compromise, many of its projects, including the establishment of refuges. This lack of funding has made the Service more apt to designate pristine lands as WLR, rather than degraded, urbanized areas, such as the Laguna de Santa Rosa. These pristine areas do not require as much management or restoration, both of which are very costly. 16

Luckily, Congressman Bosco, who asked the Fish and Wildlife service to review the Laguna, did not stop at their refusal to create a refuge. Instead, he sought to designate the Laguna in the second and least common way, through Congressional legislation.

The legislative process is often lengthy and complicated; for example before the Laguna bill is successful, it must pass through 6 Congressional phases, 6 committee movements through the Senate and 1 or deliberations in a House-Senate Conference Committee before final presidential approval. 16

Believe it or not this is only half the battle, as these proceedings

will merely authorize the U.S. Fish and Wildlife Service to acquire and draw up management plans for the Laguna refuge, but it will not provide acquisition funds. Once the bill is approved, Bosco will then have to present his case before another committee, The House and Senate Acquisition Committee, to request funds. Because of these budget cuts, mentioned earlier, actually full funding of The Laguna de Santa Rosa refuge could take years. 16

As I've demonstrated, the democratic legislative process is lengthy and complicated. Places like the Laguna only suffer further, when having to wait for proper restoration and protection. That is why I feel it is essential that areas of ecological importance be protected, by the U.S. Fish and Wildlife service, long before they are degraded, and while there is still time to wait for the slow checks and balances of our bureaucratic democracy--that seek to save them. Therefore, we as concerned citizens, students, and environmentalists, must send a strong message to our elected representatives. A clear statement--by letter writing and grass-roots organizing--that protests the slashing of the U.S. Fish and Wildlife Service's budget and funding as intolerable, irresponsible and undesirable. In addition, we must demand that the coffers of acts, that rely on general revenues, like: The Lea act, Endangered Species act, Fish and Wildlife Act

and the Land and Water Conservation Act, be filled rather than emptied,
for if we allow other species to drift into extinction, we ourselves have
little chance for survival.

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4/24/89

James Rodriguez
ENSP 321
Dr. Jean A. Merriman
May 18, 1989

THE EFFECT OF GROWTH
ON LAND USES AROUND
THE LAGUNA DE SANTA ROSA

INTRODUCTION

When I began my research on the Laguna De Santa Rosa, it was as an outsider to Sonoma County. Having just moved up to Rohnert Park in January to attend the spring semester, I was not at all knowledgeable of current events in the area. By following the newspaper and recent articles from class, my understanding of the issues concerning the Laguna grew. I also became aware of the vast conflicting interests involved in what to do with and about the freshwater marsh. Since my major is planning, I decided to incorporate my field of study into the research project. By describing land uses and their effects around the Laguna, hopefully I can express my findings and concerns about what to do with this extremely valuable natural resource.

WHERE I FOUND MY SOURCES:

I gathered the bulk of my information for this report from three main sources; The Environmental Resource Room(Rachel Carson Hall, Room 5) for ENSP students, the Rueben Salazar Library on campus, and from the Environmental Center of Sonoma County located in Santa Rosa. Augmenting these resources were

the Planning Department of Sonoma County and from a public hearing addressing the Laguna (April 6, 1989). These sources yielded a virtual plethora of text on land use surrounding the wetlands. Thus, narrowing the scope of my report was a difficult task in itself. The result was to limit the discussion of land use analysis as it relates to effects of growth around the Laguna.

FINDINGS

The Laguna De Santa Rosa is a major tributary of the lower Russian River located in Sonoma County, California. It flows south to north through the Santa Rosa plain. Originally, the fourteen mile long inland wetland existed in dense riparian landscape.

Land uses around the Laguna include residential, flood plain, agricultural, wastewater disposal, recreation and resource conservation. The land use map included in the West Sebastopol specific plan, shows that agriculture is the dominant land use around the wetland (See Appendix A).

However, within the last 10 to 15 years the area has accommodated much of the growing demand for rural-residential housing occupied by people whose main income is not agricultural based but urban and suburban employment. Recently, there has been a steady migration of people from the urban city areas to the rural suburban areas of the countryside. More people are settling for the commute to the city and the fresh

air of the country. Others wish to settle in these areas to retire.

As a result, dramatic physical changes have occurred. The orchards surrounding the wetlands have sprouted houses; the education, transportation, fire and commerce systems have encountered rapidly increasing demands; the ability of local government to provide, maintain, and improve services has been strained; and the Laguna has suffered a potentially significant synergistic effect from growth.

The rush of growth into the area has caused some hasty planning decisions. Currently, incompatibilities exist between several parcels zoned for agricultural and residential uses that are mapped adjacent to each other. Agricultural uses create noise, dust, odors, and sprays. Increased residential uses lead to additional trespassing, vandalism, new fencing, and other costs.

Both agriculture and residential uses potentially impact water quality in the Laguna. From agricultural uses, point sources of pollution such as pesticides and sediment drain into the wetlands through irrigation and rain. From residential uses, non-point sources of pollution in the form of urban run-off alter water quality in the Laguna significantly. These conflicting uses may also adversely effect the waterway's use of its flood plain. At the same time, wastewater disposal, while potentially benefitting agriculture, has resulted in the displacement of established agricultural enterprises.

Besides increasing the problems of farmers and encouraging lot splits for subdivisions and other commercial uses, the rapid urban growth has increased the amount of sewage to the point where new systems or solutions must be developed. The local cities (Cotati, Rohnert Park, Santa Rosa, Sebastopol) that use the Laguna for disposal of their aggregate treated effluent are turning to the Triple Use Plan. This plan will provide for storing sewage water and using it to irrigate feed crops and pasture land. Irrigation may make the acres of land needed for effluent disposal more productive and viable for commercial agriculture.

Public works in the wetlands area include the Laguna Sewage Treatment Plant (Which is used for treating the collective effluent from the afore-mentioned local cities), ponds and irrigation lines, and several test wells. Although the dominant land use of the area is agriculture, additional uses also include serving as a fish and wildlife habitat and spray irrigation of sewage effluent during the dry season. The stream itself serves as a disposal transport system for sewage effluent during the wet season. Portions have been cleared and channelized to accelerate drainage of some areas, in order to lengthen the agricultural growing season.

Low flatlands in the floodplain are used almost exclusively for grazing of dairy and beef cows and production fodder and silage. On the western hills are found many fine orchards

and vineyards, as well as grazing. This agriculture has been profitable in the past.

The major income for the city of Sebastopol is the apple industry. Economic pressure has increased due to urban growth and the higher taxes and other problems it brings. Approximately one-third of the land in the Laguna is in agricultural preserve.

Zoning plays an important role in the selection of land uses around the Laguna. Two zoning types in particular play an especially important part in limiting development in areas adjacent to the wetlands. The zoning designations F-1 (flood plain, level one) and F-2 (flood plain, level two), are used primarily for exclusive agriculture. The reason for this is that any major development (i.e., commercial and/or industrial) on this area would be destroyed or severely damaged during flooding. Both of these zoning designations can also be subject to minimum lot sizes. These minimum ratings can help preserve open space, but they also show the increased pressure of lot splitting and urban development. This can be seen along the fringes of Sebastopol and Santa Rosa.

Both F-1 and F-2 zoning protects the area from major development, but does not protect the riparian vegetation, wildlife or waterways from other forms of encroachment. Other measures to do this have yet to be taken, for agricultural practices and wastewater treatment have been detrimental to the Laguna.

SUMMARY AND CONCLUSIONS

The Laguna area would be best suited for use as a buffer zone. In this way, the area would serve the purpose of providing an open space between the wetlands and the urban development occurring around it. It would also prevent the Sebastopol region from becoming another heavily urbanized suburb. Suburban sprawl similar to the Bay region or Los Angeles would be deleterious to the Lagunas' well being. Measures need to be taken to stop this from happening before it is too late to rectify.

At the location where the water of the Laguna recedes each spring, large areas of rich and fertile soil are left behind. This land is great for agricultural purposes. Yet, this land should not necessarily be used for its highest monetary value. By pushing aside the obvious economic benefits of this land use in favor of using the area as a buffer zone, the wetlands would be much better off, ecologically speaking. In addition, the quality of life for the citizens of the Sebastopol region would be placed at a high level of scenic and natural beauty. By setting the importance of citizens' lifestyles above economic gain, the area would become truly unique, as is the Laguna.

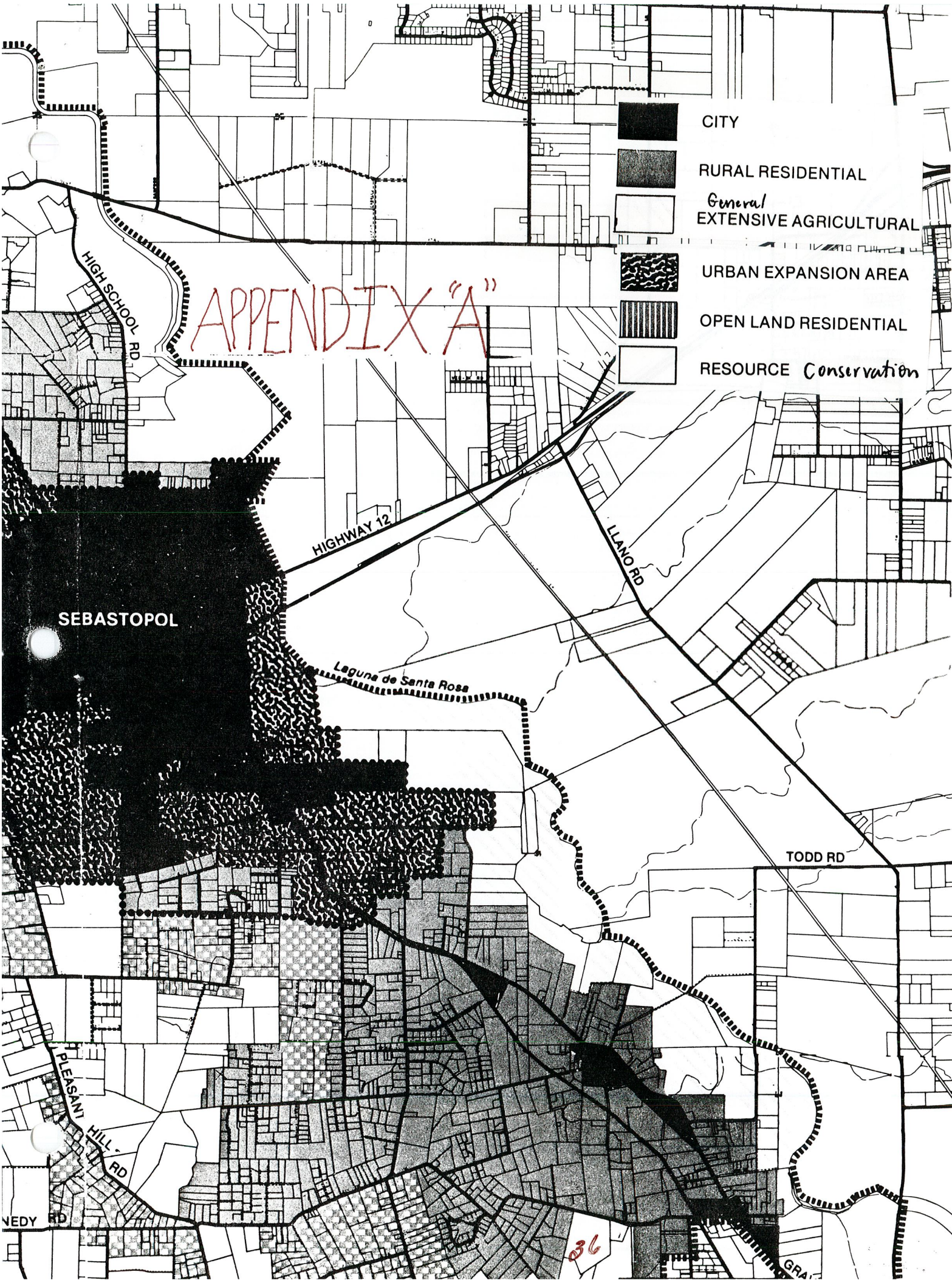
The wide open fields and spacious pastures are a very necessary buffer zone for the wildlife in the wetlands area. They provide resting places for the non-aquatic wildlife. This productive open space should remain this way.

A list of the possible solutions for the problems that growth creates for land use around the Laguna area would be endless. However, it is pertinent that a buffer zone exist around the cities that border the wetlands for the environments' benefit. This not only applies to current development, but for future building proposals as well. This can be accomplished by using planned area zoning based on population dynamics. Overall, the Laguna De Santa Rosa's maintenance as a valuable natural resource should remain the top priority. The benefits of its existence, as opposed to the adverse impacts of living with the wetland ecologically damaged or destroyed, is far too great to risk.

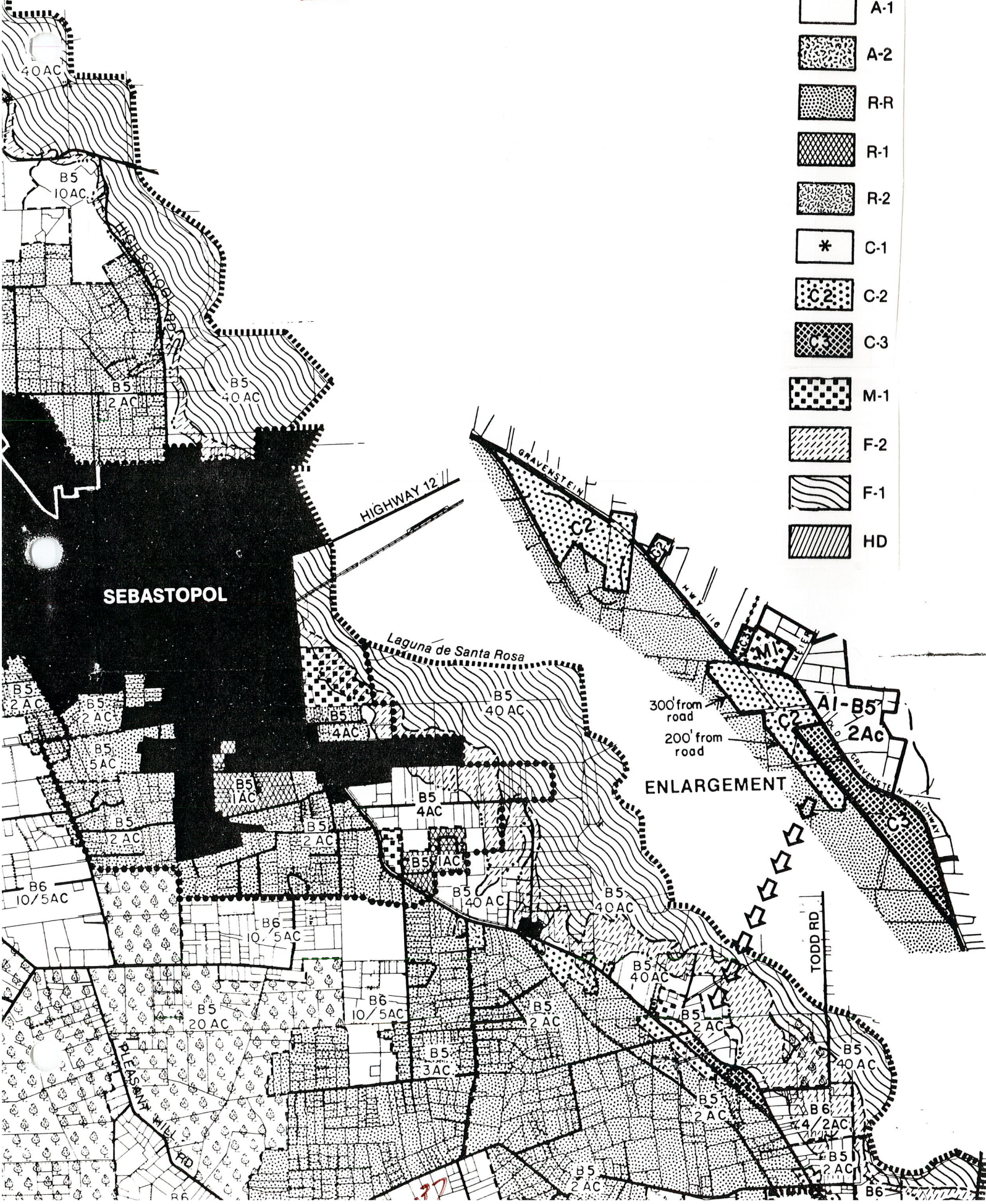
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APPENDICIES



APPENDIX "B"



PESTICIDES AND SOILS AROUND THE LAGUNA DE SANTA ROSA

By Abigail R. Chavez

For
Dr. Jean Merriman
The Biological Environment
Department of Environmental Studies
and Planning

Due: May 18, 1989

THE LEADING TRAIL

Interest leads to ideas, ideas draw you into new areas of exploration, new areas may hold more interest, and the pursuit of knowledge continues. The research on the Laguna de Santa Rosa was like that. Every time I tried to focus on a specific topic, I found myself being led by my own curiosity into another realm. Each succeeding idea led me deeper into the complexities of the Laguna de Santa Rosa; it became a leading trail.

I started the project with little idea of what the Laguna de Santa Rosa was. If someone had asked me in January 1989 to describe it I would have looked rather blank and said, "you mean the big duck pond near Sebastopol?". Several field trips and pages of reading later I wasn't quite so ignorant. By then my interest was leaning towards bank degradation and/or the possibilities of restoration of riparian habitat. By some odd round-about route I began focusing on run-off and water quality. About that time I bumped into soils and stopped thinking of them as "dirt". Soils seemed so tangible in comparison to water that I dug in (excuse the pun), and began to look at the relationship between soil types and pollution by agricultural chemicals. Hours of research later I knew I'd finally found what I was looking for, a way to tie my interest in soil, water, pollution and agriculture together.

GENERAL INFORMATION

The area that I took into consideration is the Laguna de Santa Rosa, south of Highway 12 and east of Highway 116. It is located in the Santa Rosa Valley, in Sonoma County, California (see Appendix A). The Laguna is part of the Santa Rosa watershed, and in the rainy season acts as a flood control basin for the Russian River.

The bedrock beneath the Laguna was formed some 60 million years ago, during the Mesozoic Era. During the Jurassic and Cretaceous Periods much of California was covered in ocean and ocean sediment. This sediment was compressed and folded to form the metamorphic Franciscan Formation which rests beneath much of the Laguna today. Two other Formations, the Glen-Ellen and Younger Alluvium are also found in some areas beneath the Laguna.

POLLUTING OUR NEST

"Pesticide residues have been found in crops, processed foods, surface water, and groundwater."¹

How could this happen? Shouldn't we be outraged? Pesticide pollution occurs because 60% of the 2.6 billion pounds of pesticides sold in the United States are used on the agricultural crops that we consume. That is about 13 pounds of pesticide per year per person. We are all

¹ The Washington Spectator, Nov. 15, 1988

responsible in part for the demands placed on the production standards of agriculture. If we were more lenient in what we thought produce should look like, the use of pesticides could easily be reduced. Considering the huge amounts of agricultural pollutants that are used, is it any wonder that pesticide residue shows up where it isn't wanted?

In regard to the Laguna de Santa Rosa and surrounding area which produces corn, apples, and grapes, what agricultural chemicals are used and where do the residues end up? I began looking to see what pesticides are used on these crops, or in the close vicinity of the Laguna. I wanted to know if they were affected by the type of soil: did they run-off, percolate, accumulate? What happens after application? As has been drilled into my head this semester, there is "no away", so where do they go? If Sonoma County is comparable to the rest of California, and other states, we might want to beware. The residue from pesticides and other pollutants end up in wells, aquifers, the air, soil, and surface water, just to name a few.

SOURCES OF POLLUTION

The two principle sources of pesticide pollution in the United States are run-off and aerial spray drift from agricultural lands, and discharge from industrial pesticide manufacturers. In this paper it is the former that I will

be referring to. Other sources of pollution to the Laguna are municipal sewage releases, wastewater from the apple processors, and animal wastes from local dairies. The sources and pollutants I will be focusing on are pesticides used for agricultural practices and carried by run-off.

THE POLLUTANT PLAYERS

The degradation of organochloride and organophosphate pesticides, like Endrin, Malathion and Diazanone are affected by a variety of factors. Breakdown of these compounds is dependent on organic content, soil type, moisture, temperature and microbial biota, to name the major ones.

Organochlorides are relatively "hydrophobic", they are not readily water soluble. The effect that these pollutants could have on the Laguna is dependent on their solubility. Because the organochlorides are more likely to have tight bonds with soil particles, they have a tendency to travel as suspended particulate matter in run-off water and settle quickly to the bottom of the Laguna. They may remain bound to the soil for extended periods of time, so although the water may have very minor amounts of pollution, if disturbed, the pollution factor may substantially increase.

The persistence of pesticides is increased by the larger internal surface of clay which promotes stable soil-pesticide bonds. Both the organochlorides and organophosphates are more readily adsorbed into soils rich

in organic materials and with higher clay contents. Sandy soils adsorb the least of the pesticides, with increases running up from silty clay, light sandy clay loam, coarse silt, silty clay, sandy loam, clay loam and muck. This factor of soil composition will be discussed at greater length later.

The organophosphates are less persistent than the organochlorides. Their degradation is measured in a matter of weeks, rather than years. The more rapid degradation of these organophosphates is due to the fact that they have a weaker bond with the soil particles which makes them more mercurial. Water increases the rate at which they are volatilized. Soil moisture reduces soil bonds for these chemicals by filling adsorption sites in the soil structure that could be used by the organophosphates or the organochlorides. Soils with a high moisture content are inclined to promote leaching of the more soluble pesticides. Temperature also may cause variation in degradation time. Lower temperatures reduce the speed at which the processes of volatilization, and chemical and/or bacterial degradation take place. (See Appendix B).

LAGUNA SOILS

The land around the Laguna is rich agriculturally. It supports a variety of agricultural crops, from hay to

orchards, each with different pollution problems. This is due to a number of different soil types, characteristics of each, and pesticides used on them.

****Clear Lake-Reyes Association****

The Clear Lake-Reyes Association, commonly called Clear Lake Clay, a rich floodplain soil. The Laguna has several locations where it may be found (refer to Appendix A).

Clear Lake Clay as it sounds is high in clay content, and although it is underlain by gravel it is quite impermeable. It drains so slowly that it tends to pond and the 0-2% slope limits run-off and erosion to minimal amounts. The water table beneath this is quite high, 3-5 feet from the surface.

Clear Lake Clay is one of the "safest" soils used for agriculture around the Laguna. The land is used primarily for raising oat-vetch and oat hay, or pasture. Pesticide are used very little. Much of this area is irrigated with wastewater effluent during the dry months; in the winter it is often flooded by water backed into the Laguna from the Russian River. This nearly year-round rinsing degrades, or removes by run-off, build up of pollutants that might occur in the soil.

****Pajaro Association****

Of similar composition and uses is the Pajaro Association, a clay loam, or sandy clay loam. It is a depositional soil found in the seasonal floodplain, and like the Clear Lake Clay, it too is underlain by alluvial gravel.

The slope of the Pajaro Association is only 0-2%, relatively level which reduces run-off. The high clay content and large amount of organic material speeds the ~~de~~gradation processes of pollutants, as does the slow infiltration rate which leaves the soil wet and even ponded until early summer. The slow infiltration rate is greatly influenced by the high 3-5 foot water table. Since this soil type is used mostly for pasture, pesticide pollution is not a major hazard. The seasonal flooding tends to breakdown and remove pollutants.

****Huichica-Wright-Zamora Association****

The third Laguna soil with high clay content and limited use as agricultural land due to very slow permeability and drainage is the Huichica-Wright-Zamora Association. In the Laguna area it is another "safe soil" with regard to pesticide degradation. It is high in clay content, nearly level, and has a thick layer of clay hardpan about two feet below the surface. This decreases the risk of pesticide pollution in three ways. The clay helps speed the degradation, there is minimal run-off, and leaching pollutants are stopped from reaching the water table when they become bound to the hardpan layer. The soil's slow permeability also makes it useful only for pasture and hay production which require few pesticides.

****Yolo-Cortina-Pleasanton Association****

The Yolo-Cortina-Pleasanton Association is a fertile gravelly sandy loam. It is quite level, with a slope of only 0-2%. The high gravel content makes this soil's permeability and infiltration rates very rapid. Due to the excessive drainage this soil is often irrigated in the summer months.

The Cortina soil supports vineyards and orchard, both of which have a variety of agricultural chemicals used on them. The vineyards have sulfur, fungicides and organophosphate insecticides (Dursban) used on a regular yearly basis. The pesticides are sprayed from the ground if possible to eliminate spray drift. Aerial spraying is done only when the soil is too wet to use a vehicle without damage. The orchards and the chemicals used there are the true culprits when it comes to the threat of creating a pollution problem. The pesticides most commonly used in the orchards are Ethion, Malathion and Diazanone.² These are both persistent organophosphate insecticides that last at least six months (see Appendix C). They are normally sprayed in March while the trees and corresponding insects are dormant. The insecticides are often mixed with oil to reduce the solubility, this tends to keep the chemicals on the trees longer. This mixing also helps to reduce the amount of pesticide that reaches the ground and can become run-off in the heavy spring rains that are so common in Sonoma county.

2 Deputy John Westaby, Ag. Commissioners Office

The organophosphates usually make weak bonds with sandy soils. The presense of water also breaks these bonds fairly easily as these insecticides are soluble. All these factors, when added to the Cortina soil type and the summer irrigation make for the perfect conditions to create a pesticide pollution hazard. There is a saving grace here though. The lack of slope nearly eliminates the transfer of pollutants in surface run-off, as suspended particles, or in solution. That still leaves us with the question of where does the chemical go? The answer is that most of it degrades within six months (degredation being the time it takes to breakdown to <75% of the original application).

Now for the real problem, the OP's are soluable and when in soils with high moisture content they have a tendency to leach through the soil. The true hazard then is to the groundwater. It seems that by chance we have been lucky again, the OP's normally leach through only the top three inches of soil before becoming immobile, or breaking down into less harmful chemicals. There have been no specific studies on the Cortina Association and if the pesticide pollutants actually reach the groundwater, checking some local wells might be a starting point if there was a further intrest in this potetial problem.

****Goldridge-Cotati-Sebastopol-Blucher Association****

The final soil type I looked into is the Goldridge-Coati-Sebastopol-Blucher Association. This is a

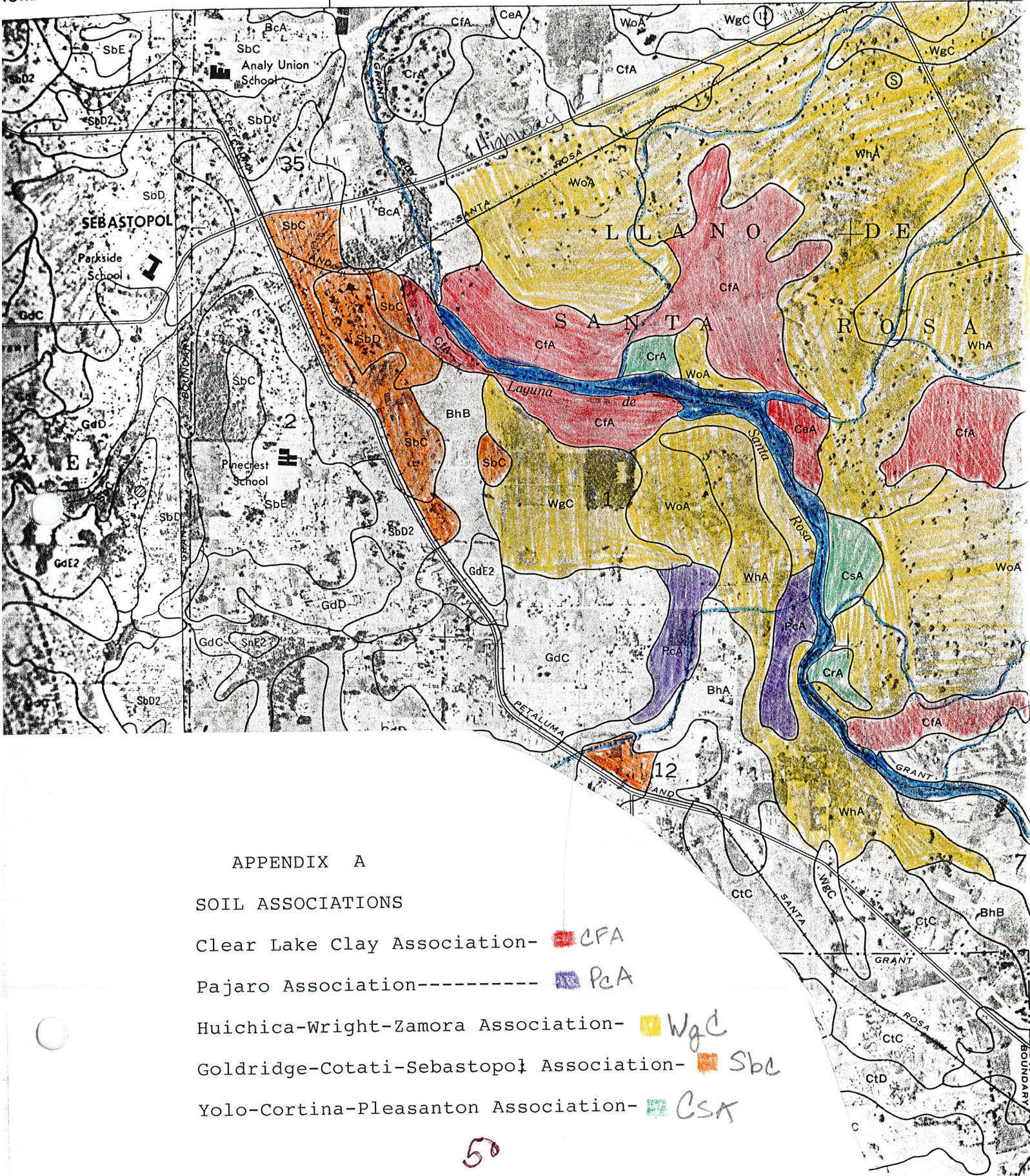
sandy loam, well drained with slow permeability. Like the Cortina it is used for vineyards and orchards, with one major difference, the slope where this type is found ranges from 2-15%. This leaves it much more prone to run-off of pesticides in solution or as suspended particulate matter. The other possible hazard is the fact that the water table is less than 5 feet below the surface. Earlier I stated that the pesticides only leach through the top three inches of soil, that should be qualified by adding in the best of circumstances. In reality about 2% of the pesticides are capable of leaching into the watertable. The Sebastopol sandy loam has the potential to allow the leaching of pollutants through to the water table. This is especially true since it is often irrigated.

CONCLUSION

From the investigation I have been involved in my conclusions are that the soils around the Laguna de Santa Rosa are fairly safe, but is the water? It seems that run-off is the major hazard, with aerial spraying and leaching into ground water far behind. How do we solve, or at least mitigate the problems?

The best solution is to reduce, or eliminate, the use of pesticides by increasing our reliance on biological controls. The next best thing is to use careful agricultural practices. Limiting erosion, and run-off, by

contour tilling, and crop cover, can greatly reduce these problems. Also supervision of irrigation, to control excesses that promote run-off and pollution of the Laguna, the Russian River, and ultimately the Pacific Ocean.



APPENDIX B

DEGRADATION PROCESSES OF PESTICIDES

Persistence of Herbicide Residues in the Soil

333

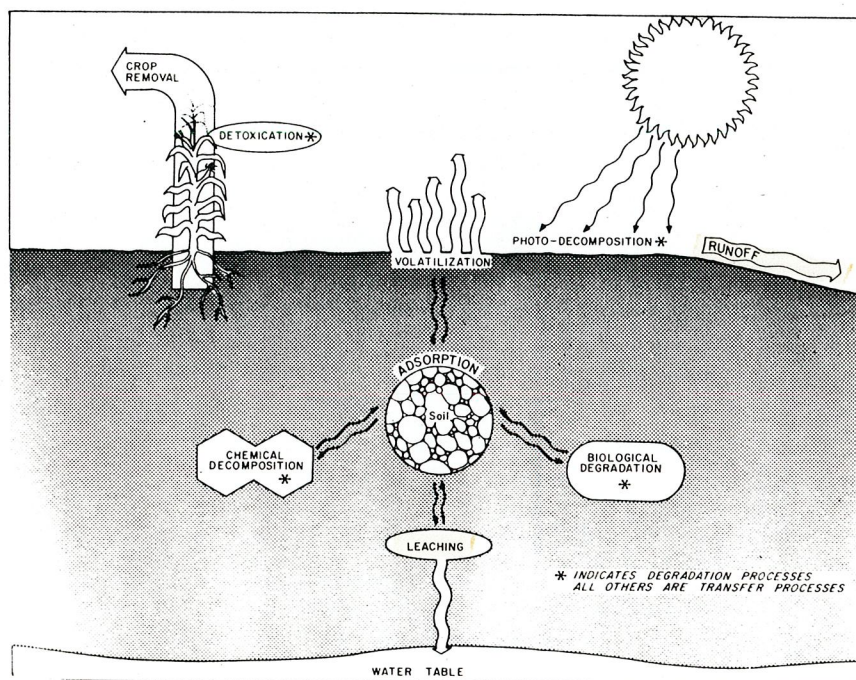


Fig. 11.3. Processes influencing the behavior and fate of herbicides in the soil (from Weber and Weed, 1974).

Reprinted from *Pesticides in Soil and Water*, edited by W. B. Guenzi, page 229, 1974 by permission of the Soil Science Society of America.

APPENDIX C

Example of degradation times for pesticides

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Insecticides and the Soil Microflora

Table 4.5. Persistence of organophosphorus insecticides in Coachella fine sand as bioassayed by *Hippelates collusor* larvae (Mulla et al., 1961; Mulla, 1964).

<u>< 2 months</u>	<u>> 2 months</u>	<u>> 6 months</u>
Parathion	Fenitrothion	Diazinon
Fenthion	Zinophos	Coumaphos
Ronnel	Phorate	Trichloronat
Azinphosmethyl	Phosmet	Carbophenothion
Disulfoton		Ethion
Dimethoate		Crotoxyphos
		Chlorfenvinphos

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Manure and its potential to pollute the Laguna

Paul Mellersh

Introduction

I have lived in Sonoma County for just over a year now. Before this class the extent of my knowledge of the Laguna was that it was a wetland area in our vicinity. I had unknowingly seen parts of it before, but it is easy to miss or to class as a stream bed. Especially to the untrained eye not familiar with wetlands. I initially had the idea of studying barnyard dairy run off when we went on our first trip to the Laguna. Right next to the standing water was a dairy farm. The ground around the barn was heavily trampled and piles of manure were oozing out of the barnyard which went down the gully like field, towards the Laguna.

The purpose of this report is to explore the potential cattle manure has for polluting surface water and the Laguna.

History

For hundreds of years farmers have been farming the area around the Laguna. They often located their barn yard right next to a creeks this gave them an easy way to dump the farms effluent. According to Authur

LaFranchi

the farmers used to joke about how the fish downstream would be the most healthy fish around because of all the nutrients in the manure.¹

¹Personal contact with Authur LaFranchi at a Laguna Meeting put on by the League of Women Voters in Santa Rosa, April 4th 1989.

Unfortunately it doesn't work that way, and I am sure that because of this pollution there were large fish kills in the Laguna. Most farmers are now wise to this problem and there are laws that prohibit it. However the problem still exists, farm run off still occurs that makes its way into the creeks and thus into the Laguna. A classic example of this is what happened at the Cunningham Dairy just off Petaluma Hill Rd. The wastes from the animal confinement facility consists of washwater manure, and urine. This mixture is usually discharged on the property either as a liquid to a pond system for storage eventually to be disposed by irrigation, or stacked as a solid for spreading at the end of the summer. On April 6th 1989, in response to a complaint, the staff of the Regional Water Quality Control Board requested the Sonoma Dairy Action Committee to inspect the facility. On April the 7th 1989, an inspection of the Dairy determined that a discharge of manure waste had resulted from a broken manure water line. The manure waste was flowing and ponded in a drainage tributary to the Laguna de Santa Rosa. I visited this tributary and found a foul smelling creek of what seemed to me to be pure manure. Apparently the pollution had extended for over three miles of the creek.

What is so bad about cow manure?

In small amounts manure is not a problem, nature has its own way of treating and diluting it. This has been happening with wild animals in nature for a long time. However with the advent of the domesticated animal, and the concentration of these animals on small pieces of land, the natural processes no longer work as well and pollution occurs. Manure, in its decomposing process requires oxygen, thus when it finds its way into a body of water it sucks the oxygen out of it and thus suffocates the fish. Studies

have shown that considerable length of streams can be devoid of oxygen due to barnyard runoff. The high nutrient value of water polluted by manure offsets the balance in an ecosystem by causing algae to grow. This in turn reduces the oxygen in the water, and by covering the body of water, it alters the temperature, which in turn changes the habitat of the pond, lake, or stream.

Runoff

Runoff from the farm yard and manure holding areas is a major point of pollution. The type of dairy dictates what kind of manure consistency and thus the disposal method to be used. The two different kinds of barns used are Stanchion barns, and Free Stall barns. With stanchion barns bedding is used. The manure and bedding are removed together, forming a dry mix solid in consistency. Most of the dairys around Sonoma County are of the free stall type². Free stall barns do not use bedding material, so the waste is a liquid combination of manure and urine. The barns are usually flushed out with water, making the mixture more liquid. The consistency of the manure is also altered if the milking parlor wash water is mixed with the manure. The different consistencies of manure cause different containment problems in the way they are stored. Stanchion barn manure and bedding is stacked in storage areas during the time when it cannot be spread on the fields. The manure in these areas will drain, and the seepage liquid that comes out of these piles has a high potential for pollution. This can be mitigated by seepage collection tanks or ponds, followed by irrigation of the collected seepage on crop land.³ When the manure is more liquid there are

²Personal connection with Rick Bennet from the Farm Advisors Cooperative. May 1st 1989

³Pollution Control For Agriculture, Second edition, 1984, Richard Loehr, Academic Press Inc
p72

a few different kinds of oxidation ponds that are used to treat the effluent.

Aerobic Lagoon

Aerobic means "with air". These ponds are relatively shallow, diked structures with a large surface area to maintain aerobic conditions. Their predominant use is in areas with adequate sunlight, wind action, and available land (they use up a lot of space). These ponds decompose organic matter solely through aerobic oxidation. The oxygen is obtained through mixing and photosynthesis. The mixing of the ponds occurs by liquid recirculation wind or mechanical movement. The oxidation ponds approach natural purification more closely than any other treatment process. Algal cells are used in this process of waste treatment. Detention time of manure is between 5 and 10 days.

Facultative Ponds

This is the most common kind of pond, they have aerobic conditions in the upper layers and anaerobic processes occurring in the lower layers. They are deeper than aerobic ponds. They utilize the purification methods of the aerobic and anaerobic processes. Detention times are often greater than 30 days.

Anaerobic Digesters

Anaerobic means without air, so the effluent is treated in an airless container. The bacteria that breaks down the manure produces methane as a by-product. This fuel is used in some cases to generate electricity. The heat generated is used to clean the milking parlor and equipment. The effluent from the digester is sometimes fed back to the animals as the dead

anaerobic bacteria have a high protein content. The disadvantages of this method are that the initial cost is quite expensive. This kind of lagoon creates the destruction and stabilization of organic matter, yet it doesn't purify the water. It does reduce the biological oxygen demand and although effluent from a digester is unlikely to be suitable for discharge to surface waters, it may be suitable for spreading on the land.

Lagoon Maintenance

It is important that the retention lagoons be kept in good shape and cleaned on a regular basis. Manure handling equipment must also be maintained. Sonoma County is an example of what happens if this is not done. In the mid 70s new laws came into effect that put requirements on farmers to stop manure pollution from reaching ground and surface waters. By 1980 most of the farmers had complied. However these laws were only enforced through public complaints. This led farmers to become more complacent about maintaining their equipment to abide by these laws. Add to this two years of drought and the addition of more animals on the same amount of land and you have a problem waiting to happen. This March heavy rains fell on Sonoma County and many of the manure lagoons overflowed and found their way into the waterways and into the Laguna. This has drawn the attention of many farmers to the poor shape of their manure handling system, and a lot of money is expected to be spent to bring their systems into good working order. New laws have also passed that if the wastes from your farm finds its way into a fish habitat, and it is found to be toxic, a citation will be given. This is a misdemeanor carrying a fine from a few hundred to several thousand dollars for a first offense.⁴ Another way to

⁴Personal contact with Rick Bennet from the Farm Advisors Cooperative. May 1st 1989

alter the way farmers treat their waste is through codes and guidelines. The guidelines often suggest waste storage capacity and distance from human dwellings. The guidelines can also set the criteria for satisfactory waste handling and treatment facilities, odor control, solid waste disposal and runoff control.

These guidelines are found in the states of New York, Wisconsin, and Ontario (Canada).⁵ The advantage of these codes are that they represent the best available techniques, yet they can be altered if a better alternative comes up.

Land Application

The only economical disposal of wastes is on the land. According to Aurthur LaFranchi "If we can't dispose of the manure on the land we might as well pack the whole thing in".⁶ There are a few different kinds of disposal methods: Sometimes the effluent is sent through a separator to remove most of the solids. These are often dried, stored, and used as bedding. The liquid left over is pumped to the fields and used as irrigation through large orifices. Another way it is dealt with is by breaching the pond with a scoop tractor, then loading its contents (which are mostly solids by the end of the summer) into a spreader for distribution on to the fields. This is done during the dry season from mid April to October. If an anaerobic digester was used to treat the waste the effluent would be disposed of in a way similar to the first method described.

Point Source and Non Point Source

⁵Agricultural Waste Management, 1974, Richard Loehr, Academic Press Inc, P 11

⁶Personal contact with Aurthur LaFranchi at a Laguna Meeting put on by the League of Women Voters in Sant Rosa, April 4th 1989.

The few dairy farms that are around the Laguna can control their point sources, and will be pressured to do so under the watchful eye of the public, and the Fish and Game wardens. The major problem of dairys in the Laguna area is with non point pollution. Animals are defecating and urinating in streams that feed or are part of the Laguna. The removal of animals from stream beds is usually recommended as part of local or regional water pollution control.⁷ However grazing the creek side has other benefits such as reducing fire hazard of overgrown brush. Meadow Foam also doesn't compete well with grasses. So the domestic cow serves a purpose to save the Meadow Foam from the non native imported grasses. The Laguna originally had elk in its habitat. The domestic cow has now taken its place.

Summary

To protect the Laguna from pollution from dairy farms, no new laws, specific to the Laguna, need to be brought about. The farmers need to update and maintain their equipment to meet current standards, and the laws that pertain to these standards should be enforced. Cattle access to streams could be limited on a time of year basis, enabling the cattle to graze the grass that would choke out the Meadow Foam. Limiting the access of the cattle would limit the amount of pollution that would enter the stream. Further research could be done to find out the feasibility of this suggestion.

⁷Agricultural Waste Management, 1974, Richard Loehr, Academic Press Inc, p42

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FARMLANDS PRESERVATION

by Lynne March

INTRODUCTION

I remember Sonoma County before it had malls. I remember when Highway 101 came through and was thought to be extravagant. I learned to drive out in East Petaluma so I'd have little chance of hitting anything. Rohnert Park didn't exist. If anyone thought about the Laguna at all, they were glad someone was out there making use of the land - draining it and improving it. The Laguna is still there, but much of what I knew as farmland when I was a girl 30-35 years ago is paved over. I wouldn't want to see the rest of the farmlands gone forever. This paper is an attempt to understand the why of what has happened and to explore the possibilities of curbing the trend. The Laguna de Santa Rosa is used as an example of the various forces that have caused farmlands preservation to be the important concern it is. John Muir made a visionary statement on growth and preservation that applies so perfectly: "Not blind opposition to progress, but opposition to blind progress," (used by Martin J. Rosen, TPL).

RESEARCH GOALS

Being a environmental studies student, I felt confident that I understood the environmentalist viewpoint. I, therefore, concentrated my efforts on attempting to broaden my scope of understanding. First, I sought out scholarly works to gain insights into the scope and causes of the concern, and to research what implementation ideas were promising. I also clipped articles about the farmlands issue. I particularly wanted to explore the views of the farming community for I had an innate sense that a discussion of farmlands

preservation without consideration of farmers would be dogmatic and useless. I wanted to talk with people who had ideas about preserving farms locally, and conversely, to gain from them an improved knowledge of the forces working to destroy farms.

FINDINGS

I discovered that the farmlands preservation issue is multifaceted in nature. Traditional thinking about what "land" is collides with changing concepts. The issue is one of competing interests and conflicting values. What emerges, however, is that various people with various motivations are interested in seeing farming continue in Sonoma County, and in the Laguna in particular. Areas of common interest lead to limited hopes of reaching goals with pragmatic approaches. It is my opinion, however, that unless there is a politically strong coalition of interests soon, Sonoma County will not maintain its rural character far into the 21st century. The Laguna de Santa Rosa is not a simple example of the farmlands preservation issue. Complicating it are the Bosco refuge proposal with questions regarding compatibilities, and the wastewater issue with questions regarding potential opportunities and drawbacks. While the Laguna wetlands may be preserved longer, development could fringe it. Eventually, it could be an urban park, refuge for neither farmer or waterfowl. Although Congressman Bosco's assistant, Joel Rogers, assured that there would be "no new regulations" for the Laguna, many farmers already feel "regulated to death."⁽¹¹⁾ They are apprehensive and regrettably ill-informed about what is proposed for the lands they farm.⁽¹⁴⁾ Longtime rancher, Russ Denner, is fond of saying "farmers are an endangered species."⁽¹⁴⁾ That may well be too true unless there is real community commitment to preserving farmlands and farmers.

CHANGED THINKING

During the last several decades two principle factors have lead to great changes in the way land is regarded. They are: 1) population dynamics, and 2) environmentalism.

Population Dynamics

Because of population dynamics, development pressures bear seductively on ever more lands. These pressures lead to real, and/or projected, scarcity. In the North Bay region the population rose 25% between 1977 and 1988.(16) Loss of farmlands is palpable. Across the nation it is estimated that we are losing three million acres of farmland annually.(12) The problem with population is not sheer numbers alone, but also its distribution and character. This, of course, relates to societal mobility. "Areas once considered almost wholly rural by past perceptions of the term . . . now resemble suburban America - in economy, in lifestyle, in the sprawl that is now apparent almost everywhere."(3) In 1980, parcelization was identified as the single largest consumer of farmlands in our region.(10) If urban growth was ideally compact, the symbiotic relationship of producers to consumers could more easily be maintained. Instead, as Jim Gallagher, Sonoma County Tax Assessor, confirmed, growth has been scattered and leap-frog, making the urban fringe difficult to even delineate.(14) Sonoma County has followed the pattern of the conversion process: first there are nodes of growth in rural areas, then speculative increases, taxes rise, nuisance suits begin, pressures for services such as water and sewers develop, and ultimately annexation.(4) Joan Vilms of the Sonoma Land Trust (see chart) said that when speculation precedes development, real estate markets are heated up, generating expectations for quick profit. This economic uncertainty is destructive - undermining "long

term resource management decisions."(18,19) The climate of uncertainty causes capital investments to decline making farms less viable.(10) Furthermore, agricultural lands are frequently idled prematurely.(3)

Here, as is typical in other urbanizing areas, long time farmers have watched the value of their land appreciate. "Many a farmer or rancher views his land as a bank account to be tapped whenever circumstances warrant."(6) Many Sonoma County farmers have availed themselves of this instant cash by subdivision sell-offs or sell-outs. According to Bev Wasson, President of the Sonoma County Farm Bureau, some of the younger farmers are realizing "that if it continues, there won't be any property left to farm."(20) The net gain between selling at \$25,000 per acre for vineyards and \$75,000 per acre for houses makes conversion pressures overwhelming, she elaborated. It becomes clear why both she and Joan Vilms expressed the farmer's attitude as "If you want it, buy it." Rick Bennett, of the University of California Farm Advisor's office, works closely with farmers. He stressed that good management technology will keep many farms economical, but that land appreciation county-wide is much faster than rises in agricultural productivity.(1) Farmers clearly stay in farming for reasons aside from pure profit.

In the wetlands part of the Laguna, the parcelization/ranchette phenomenon and conversion pressures are limited by the hydrology. However, not even flood plain zoning is sufficient to protect from development.(1) Bev Wasson put it more bluntly. She said, "you have to realize that if you have ever gone down and looked at the Los Angeles River, you can cement anything."(20) While not proposing this, the point was well made that if demand for land rises with great population increases, no land is safe. Ironically, with around 3% of the population producing 100% of the food, the value of farmlands and farmers escalates in proportion to population increases.

Environmentalism

Forty years ago Aldo Leopold articulated his land ethic, calling for land not to be regarded as a mere commodity. Twenty years ago, Ian McHarg formulated some of the first thinking of ecological principles, principles that are now moving into mainstream thought. He fostered an appreciation for natural processes and functions, building a case that "nature performs work for man - in many cases this is best done in a natural condition." (9) He suggested that certain lands be protected. For example, those important for water purification, atmospheric pollution dispersal, climate amelioration, water storage, flood, drought and erosion control, topsoil accumulation, forest and wildlife inventory increase, and spawning /breeding grounds. (9) The Laguna is, or was, just such an area.

A pragmatic environmentalist can see that farming is compatible with maintaining many of these benefits. Combined with this is the increased awareness that productive soils are irreplaceable resources in finite supply. Farms, furthermore, provide open space, aesthetic "quality of life" values, community separators and buffers. Brenda Adelman, environmental activist, stated "agriculture is the best buffer" in reference to the Laguna refuge proposal. (8) The Laguna has long been considered the ultimate community separator between Santa Rosa and Sebastopol.

A COALITION OF INTERESTS

"What is needed, clearly, is a new land ethic - an ethic forged of our twin concerns for the land's proper use and its proper care. We must begin to treasure the prime farm lands that have made us the world's richest nation, keep them available for agricultural use, help farmers survive economically and environmentally, so that they can profitably produce from them and insist that they be used in such a manner that soil depletion is minimized." (12)

In analysis, this combines ideas of land as a resource and as a commodity. There is a strong statement that farmers are the custodians of an irreplaceable national treasure, but also the recognition that farms and farmers can only survive if farms are profitable (see chart). The reality is that for the goal of farmlands preservation to be reached, farmers must be intimately involved in and desirous of the goal. The farmers of Sonoma County would need to become a cohesive political force with a commitment to agriculture. This has not been the case. The messages have been mixed. At the same time a substantial segment of the non-farm community would need to become supportive of agriculture in ways it has not. Mere "lip service" will not do. The new General Plan of the county can act as a guide, but the record of substantial ineffectiveness of zoning and plans, calls for concerted action and openness to creative methods (see chart & 13). As awareness is raised about the costs of growth, perhaps the long term economic benefits of agriculture in providing steady revenue without high demand for services will be examined against recent trends to justify any growth as providing needed revenue sources to handle the problems growth creates (infrastructure, jails, health services, schools).(15)

Land can not be merely declared a public resource. This "ignores the crucial importance of our constitutional right to own land and to buy and sell it freely;" furthermore, "it is essential that land be treated as both a resource and commodity."(2) The farmlands issue for farmers is framed in terms of constitution rights and protections. The need of equity and fairness are powerful arguments. Some farm protection devices appeal to farmers because these rights are respected (see chart). Land trusts and purchase or transfer of development rights are key examples.(18) Wisdom is knowing that "the best

public policy is always an attempt to resolve the tension between individual rights and social obligations."(7)

Phyllis Hartley, Executive Director of the Marin Farm Bureau explained that the Marin County farmlands preservation effort has been successful because Marin farmers "recognized early on," that the environmentalists were "valuable allies."(5) Farmers were integral to the formation of the Marin Agricultural Land Trust (MALT). Ralph Grossi was it's founder. A former Novato dairyman, he now runs the American Farmlands Trust based in Washington D.C.(see chart). He is currently "working with environmental and farm groups in writing the next farm bill."(17)

CONCLUSIONS

I have prepared a chart which compares the most used agriculture preservation methods applicable to Sonoma County and the Laguna, and gives examples of applications(follows). Agricultural viability is key to all, for we are not speaking of preserving fallowed farms. Fortunately, a record \$246 million Sonoma County farm income for 1988 is "preservation" in its most pragmatic form. There needs to be a rethinking about the value of farms and an evolving societal consensus that farmland preservation is an investment well worth making. Farmers need to feel that environmentalists and urban dwellers can be allies in the goals of preserving the resource of land and of the quality of life it provides. Environmentalists need to foster community support that is constructive, and to hold no hidden agendas. There must be a middleground of goodwill and dedication to fair implementation, otherwise, the powers of development, fueled by population mass, could overwhelm agricultural interests, to the benefit of no one. Farmlands preservation is a call for rational land use .

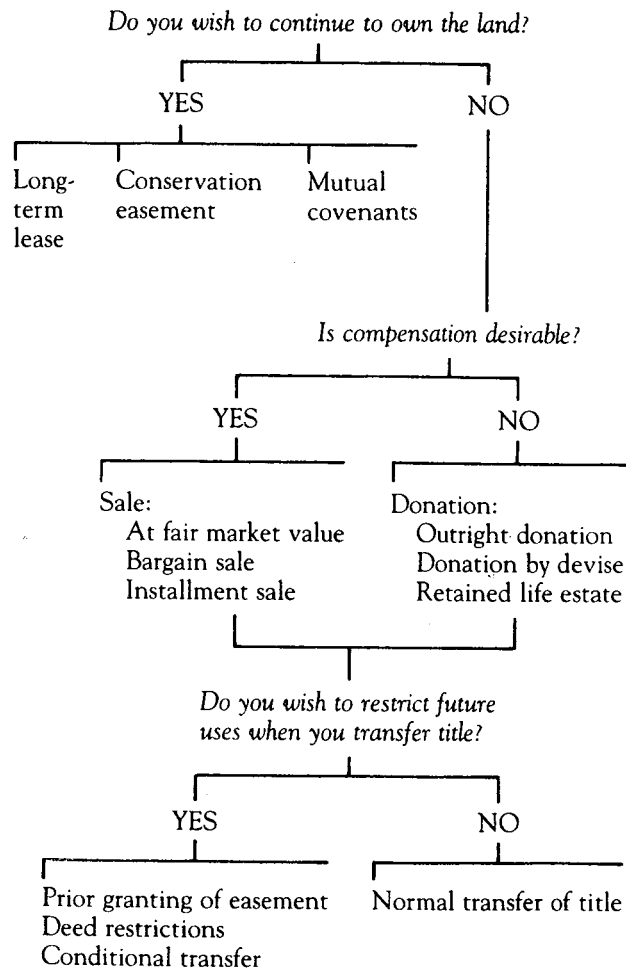
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APPENDIX A

Options for Protecting Special Land



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AGRICULTURAL CONCERNS ABOUT A WILDLIFE REFUGE

by Joann Avilla

Department of Environmental Studies and Planning

Biological Environment

with Professor Jean A Merriman

Originally I set out to report on the history of some of the long time residents of the agricultural community in the area of the proposed Wildlife Refuge of the Laguna de Santa Rosa. I quickly realized these people were expressing deep concerns that merit reporting. Right or wrong in their concerns, there exists an immediate need for communication and united efforts between the agricultural, environmental and political groups interested in the future of the Laguna. In this report I will share some of the agricultural property owners concerns as they were told to me directly in interviews as well as those observed in public meetings.

The land area identified in the 1988 feasibility study by the Laguna Technical Advisory Committee is said to total approximately 9,000 acres.(1) The vast majority of this land is presently used for agricultural purposes, primarily dairy ranching and corn and forage crops.

Questions exist as to the compatibility of agriculture and a wildlife habitat. Among the 14 goals of establishing a refuge in the Laguna as listed report Fish and Wildlife restoration of the Laguna de Santa Rosa prepared by the Technical Advisory Committee is:

#10. Encourage the maintenance of agriculture in the Laguna and peripheral lands as an important socio-economic and cultural resource compatible with wildlife management. Impose no new level of regulation on agriculture. (2)

However, in January of 1988 The Laguna Advisory Report to the City of Sebastopol reported:

One of the most cherished benefits that the Laguna provides is its function as open space between Santa Rosa and Sebastopol. With regard to management of this resource it should be noted that, while virtually any

land-use that benefits wildlife and native vegetation also provides open space, the converse is not necessarily true. Agricultural open space is poor habitat for most wildlife and native plants. (3)

Initially, a lack of communication has caused a division of the concerned citizens. At a Farm Bureau Meeting of approximately 40 to 50 members of the Laguna agricultural community, more than half did not understand the boundaries, definition or purpose of the proposal. Many different farmers expressed their fears about property values, ownership and regulations.

"No one has talked to us."

"Where did this start?"

"Who has a list of the parcels involved?"

"Economic impact is an issue but we are fighting people with nothing better to do. They don't want you in their back yard but you should keep your yard open."

"Who came up with \$3,000 an acre?"

"Our pesticides and noise will send up a flag."

"How can we get information on the proposed bill and where can we get legal representation?"

"This is like the people moving next to the airport and then wanting the airport to move."

"How could this be a park? It's full of water in the winter."

"The people the most effected are the least informed."

"Why is my land included?"

"If they buy our acreage then what does the farmer do? Go to Eureka and plant prunes?"

"Many of us could be out of business without a livelihood." (4)

No one at this meeting had the answers. Bill Dubois, a representative of the Farm Bureau from Sacramento, advised them to get the facts; not to submit to zoning of "Agricultural Only"; be aware that a wildlife refuge will not allow pesticides; and that if need be, the legal council of the Farm Bureau would represent them. He further explained that the bill may be just one of Assemblyman Doug Bosco's attempts to appease the environmental community. Bob Cummings, Biologist, concerned environmentalist and consultant for the Santa Rosa City Utilities Department was also present at this meeting. He recognized the need for including agricultural representation in the development of the plan and arranged an invitation for the agricultural community to participate in the monthly Laguna Scoping Committee Meetings which are held in Sebastopol.

Several weeks later at the meeting of the Laguna Scoping Committee approximately ten farmers were in attendance. Somewhat more informed and articulate, but still often excited, they again expressed their concerns:

"Why expand 13,000 acres when we have 95,000,000 acres of wetlands?"

"Let the owners be part of the planning."

"Regarding vernal pools, if Berretta wants to develop more pasture, will he be prevented from plowing?"

"If we cannot do with our land what we need for viable agriculture, is there compensation for that?" (5)

"I want to know how many proponents of the refuge proposal own property. The people who own land feel they have been had. . . . feel people have the means to take land and give it awayIt's always nice to give someone else's property away."

"Fencing a stream off is not compatible with

agriculture. The weeds and pests grow and multiply. Even 40 to 50 feet back doesn't work. We cultivate as close as we can to keep weeds and trash out or customers won't buy the crop.

"Keeping the public out of public lands is a real idealistic attitude. Public access always sets the stage for the few who don't want to stay on the trail. Liability is a major issue. Every property owner in or adjacent must be notified to what is happening. A lot don't know what is going on.

"We need the flow (of water) but you squawk like hell every time we yank a tree out! Right? How do you propose to mitigate that?" (6)

Bob Sharp, chairperson of the Technical Advisory Committee, and Bill Cox of Fish & Game, addressed some of the issues. It was decided that the group would contact Assemblyman Doug Bosco's office for clarification and support. They also plan to invite to the next meeting an official working in refuge management in a similar environment elsewhere in California who can explain the influence of refuge management on nearby agricultural lands. Prior to the meeting the farmers will work to identify specific concerns. Nick Nickols, Sebastopol City Council member and chair of the meeting concluded "We have a commonality of interests and need to focus on them."

The City of Santa Rosa is a major landowner of property in the proposed refuge. This land is used for storage, irrigation and evaporation of reclaimed wastewater. Additionally, the Santa Rosa Utilities (Water) Department contracts with the farmers in the laguna basin to use reclaimed wastewater for irrigation of their agricultural land. In a personal interview and at several meetings Miles Ferris, director of the Utilities Department of the City of Santa Rosa, expressed his concerns and helped explain the apprehension of the

farmers. "The City has the interest of good custodians of property owned and all represented. A plan must be based on knowledge." He went on to explain one of his main concerns, that of public intrusion. "I have reservations regarding public on City property which could easily lead to lawsuits. Crops and picnics don't mix. The intrusion could collectively have a negative effect on operations. Agriculture and intrusion do not do well." Another concern is damage to wildlife and land by hunters in the Laguna area. For the City of Santa Rosa and the farmers Mr. Ferris sees one advantage of the refuge in providing funds to enforce restrictions against the excessive hunting and shooting that is going on now.

Mr. Ferris also explained the need to protect the farmers. As the area continues to loose dairy operations there will be less service companies i.e., dairy parts houses, feed supply outlets and advisors, etc. Fewer services mean higher operating costs for the farmers such as longer trips for parts and higher prices for services. The higher operating costs cannot be passed on to the customer because the prices are competitive only on a state market level. The remaining dairies, therefore, quickly become willing sellers. "The cumulative effect will be very damaging."

Regarding a management plan to protect the natural resources of the Laguna, Mr. Ferris believes with or without a refuge, a management plan is inevitable. He specifically referred to the following actions:

1. In June, Bob Klampt of the North Coast Regional Water Quality Board will begin his research project on non point source water pollution. With particular emphasis on manure ponds, there will be

more and more pressure to avoid any run-off from agricultural lands.

2. Air pollution restrictions are increasing limitations on equipment and methods of operation for agriculture.

3. Irrigation is already monitored diligently and will continue to be so.

Mr. Ferris explained it is not the intent of the farmers to continue bad practices. "Mainly they need constructive education to learn the proper techniques." His department employs people specifically to work with the farmers to provide instructions for environmentally sound farming practices. Furthermore, the City offers classes to educate the users of the reclaimed water for irrigation. (7)

In another interview, Mr. Art LaFranchi outlined his major concerns. From a family operating dairies since 1920, Mr. LaFranchi is also a practicing lawyer in Petaluma. He and his wife manage a 320 acre family owned dairy located in the Laguna basin near where Mark West Creek enters. His concerns include:

1. " Although the proposal in the report cites land purchases will be from willing sellers only, I believe this proposal has the inborn capacity of growing on itself to move from willing to unwilling sellers.

2. If the EPA imposes the requirements for a wetland habitat of no pesticides, no herbicides and no fertilizers, this absolute prohibition will convert all farmers to sellers because they will be unable to continue to be productive.

3. Part of the proposal says there will be no increase in regulation with regard to the agricultural operation. I believe a refuge will be dependent on increased regulations and therefore the statement in the proposal is not realistic."

Citing 1988 as economically the worst year for his operation since 1960, Mr. LaFranchi also emphasized the need for a review of the

possible economic effects the refuge would impose on the dairy industry. (8)

Tim Tesconi, agricultural editor of the Press Democrat, reported he believes "the 'refuge' means 'restrictions' to the farmers". He referred to a meeting in March where Doug Bosco clearly advised a group of farmers "The EPA is going to come down on you". 9

A leader for the farm community is Stan Denner. I spoke with Stan on several occasions and his brother Russ gave me a tour of their operation. Since 1890, the Denners have farmed the area just south of the bridge on River Road. They presently farm 500 acres in the proposed refuge and another 480 acres off Westside Road. Russ explained how his father purchased some of the surrounding property including Ballard Lake, a recreational lake in the 1930s (which has since filled in with silt and is no longer there). He stated much of the land was of poor adobe soil and not good for crops. In the 1960's, the family dug a channel to let in the flow of the Mark West Creek during times of high water. This left rich deposits of alluvial silt. According to Russ this improved the creek for fish and the soil for farming. A routine operation on their property is to pull gravel from Mark West Creek for sale but the main production of the ranch is silage corn, alternated planting with alfalfa and raising cattle. All of his land is irrigated with reclaimed water from the Santa Rosa Treatment Facility. Russ was proud to point out how rich his pasture land is. He said he goes to extra efforts to put out his hay at various rotating areas so the cows spread the seed and fertilize the entire area. He said this is much better than some other "new" farmers who just feed

the cows near the barn and that ground gets over saturated with nutrients.

Regarding the refuge Russ said "We don't need the government interfering. After the family has been here for more than 100 years we should know how to take care of the land. We (farmers) need support. I am afraid the starving people won't just be in Africa if all of our farmers are put out of business." He went on to point out that most farmers in the area are not making big dollars. They do it for the love of the land. "Hardly a month goes by without a Real Estate agent calling to subdivide the ranch and telling me of the millions I could make by selling out. If the environmentalists make it too hard for us and we quit, the environmentalists lose." (10)

There is no easy conclusion to this report. The need for wildlife habitat exists. The need for farmers in the Laguna basin exists. The need for reclaimed water irrigation exists. The first need is for improved communication, education and practices of all concerned. Agriculture must have input into the development of the plan for a successful refuge. The co-existence is dependent on joint efforts.

References:

Art LaFranchi, Property owner, Piner Road Santa Rosa

Russ Denner, Property owner, Wolsey Road Santa Rosa

Cecelia Mellow, Property owner, Llano Road Santa Rosa

Judy Van Winkle, Sonoma County Farm Bureau

Sonoma County Land Trust

Miles Ferris, Director, Santa Rosa City Utilities Department

Jim Gallagher, Assessor, County of Sonoma

Anne Magnie, Mayor, Sebastopol

Nick Nichols, City Council, Sebastopol

Bob Perretta, Property owner, Llano Road, Santa Rosa

Bill Cox, California Department of Fish & Game

Bill Dubois, Farm Bureau Advisor, Sacramento

Bob Cummings, Biological Consultant, City of Santa Rosa

Bob Sharp, Chairman of the Laguna Technical Advisory Committee

1. The Laguna Technical Advisory Committee, Fish and Wildlife Restoration of the Laguna de Santa Rosa 1988 page 6
2. The Laguna Technical Advisory Committee, Fish and wildlife Restoration of the Laguan de Santa Rosa 1988 Page 7
3. Appleton, Harold et al. Laguna Advisory Commission Report to the City of Sebastopol 1988 page 14__
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5. Bob Mulrath, Property owner
6. Stan Denner, Property owner
7. Miles Ferris, Director of Utilities, City of Santa Rosa personal interview 5/2/89
8. Art LaFranchi, Property owner, Telephone and personal interviews 4/6 & 4/8/89
9. Tim Tesconi, Agricultural Journalist, Santa Rosa Press Democrat. Interview 4/6/89
10. Russ Denner, Property owner, Personal interview 3/17/89

CHERYL LINK and JOANN AVILLA

2232 Mark West Springs Road
Santa Rosa, California 95404
(707) 579-3707

March 14, 1989

Dear

We are students at Sonoma State University and are involved in a class research project on various aspects of the proposed Laguna de Santa Rosa Refuge. The aspect of the Laguna we have chosen to report on is the history, attitudes and opinions of the agricultural segment of the community. The role of agriculture is important and although we have read in the newspapers some opinions of the local farmers, we believe additional interviews are necessary to thoroughly represent your concerns.

This class project will culminate in a public presentation. Included in the audience will be members of public agencies, elected officials and concerned citizens.

We will be calling you in the next couple of days to schedule a meeting, at your convenience, to conduct a personal interview. We welcome your referrals for additional interviews and thank you for your help.

Sincerely,

WILDLIFE LAW ENFORCEMENT
AND ITS ROLE IN
NATIONAL WILDLIFE REFUGE MANAGEMENT

by Gregory Lewis
for The Biological Environment, ENSP 321
Spring Semester 1989
Dr. Jean A. Merriman

"The enforcement of laws and regulations has always been an important element in any wildlife conservation program. Historically, regulation of the use and protection of wildlife is one of the oldest conservation concepts. Unless there is a drastic change in the human race, law enforcement will always be necessary to the maintenance of wild creatures."1

Ira N. Gabrielson from the foreword to
Wildlife Law Enforcement by W.F. Sigler, 1972

The Laguna de Santa Rosa, a fourteen-mile remnant of marshland which lies between Rohnert Park/Cotati and the Russian River, has been proposed as an addition to the National Wildlife Refuge system by Representative Douglas Bosco. The refuge would consist of 9,000 acres of land surrounded by the communities of Rohnert Park, Cotati, Santa Rosa, Sebastopol and Forestville. Much of the land involved is today owned by agriculturalists. The City of Santa Rosa owns about 2,000 acres in the area. The California Department of Fish and Game and the Sonoma County Water Agency separately own land totalling about 400 acres.

The greatest impact upon the Laguna has been and will continue to be the burgeoning local population and the resultant residential and commercial development of the area. Congress must decide, weighing the interests of all parties and of the habitat and wildlife, whether to preserve part of our dwindling wetlands heritage (vanishing at an alarming rate of 300,000 acres per year²) or to accomodate the needs of the ever-expanding North Bay Area populace.

There are legitimate concerns expressed by two groups of people with direct current links to the Laguna. Farmers are concerned about the government's land acquisition plans (though they have been assured that land will be purchased on a voluntary basis only) and any regulations which might restrict their operations. Residents of communities downstream of where the Laguna flows into the Russian River worry about the effect upon the Laguna's floodwater holding capacity during the winter months if treated effluent is used to supply water for the wetland.

Some members of this class investigated issues which need to be examined prior to the establishment of a refuge. Some explored the restoration effort which will be necessary to achieve a successful and balanced wetland and associated riparian habitat. My hope is that a viable management plan will result which will win the support of those who now oppose the establishment of a wildlife refuge in this area.

Based on the assumption(or hope) that Congressman Bosco's bill will be successful and that the refuge will become reality, I will discuss the role wildlife law enforcement plays in maintaining the health and integrity of the refuge. I will stress the positive functions of educating the public about the need for protective laws and maintaining stability by winning voluntary compliance with the laws before harmful impact occurs. I will summarize the history of wildlife law, illustrating how it has changed. It has been proposed by the Laguna Advisory Committee, in its report of August 1988, that while the federal government, specifically the United States Fish and Wildlife Service(Dept. of the Interior), will own most of the land on the refuge, the resources should be managed by the California State Department of Fish and Game. In light of this, I will examine jurisdiction. Whose laws will apply and who will have enforcement authority?

My interest in wildlife law enforcement stems from my seasonal occupation as a trail and backcountry ranger at a wildlife refuge in Alaska. I work closely with U.S. Fish and Wildlife enforcement rangers and with officers of the Fish and Wildlife Protection detachment of the Alaska State Troopers. I admire their devotion to helping foster a respectful wilderness ethic in the resource using public. Most of their efforts are directed at educating the public about the benefits to everyone when respect and appreciation are exercised in nature. The tools most often used are a friendly demeanor, advise, pamphlets and natural history observations, rather than warnings, citations or handcuffs.(Warnings and citations are sometimes necessary, but actual arrest has been rare at our refuge.)

When one thinks of law enforcement, the most common image is that of the blue knight, guardian of safety and upholder of the law. Unfortunately, in this day and age, our attention is often directed at the negative aspects of the enforcement officer's job. It seems he or she is ever engaged in the apprehension and arrest of violators as criminal activity becomes commonplace.

George D. Preston, in the preface to William F. Sigler's Wildlife Law Enforcement, states, "Enforcement is a harsh word. It implies compulsion. The connotation of the word 'compliance' tends to soothe the nerves and heart of the outdoor man and woman."³ Wildlife law enforcement has a more positive image than police enforcement in the public consciousness. Most would agree that wardens and rangers perform a constructive duty by helping to maintain healthy wildlife populations. The duties of wildlife law enforcement rangers are more varied than those of a police officer. Rangers are also naturalists, resource planners, biologists, guides and emergency medical technicians. Whether performing the duty of law agent or host or interpreter, the main objective is to convey a respect for nature to those who visit and use our natural resources.

The National Park Service, also within the Department of the Interior, has led the way in training resource management personnel in the practices and philosophy of wildlife law enforcement. Their training courses are used by employees of other federal agencies, including the United States Fish and Wildlife Service. (More specialized training is offered by the FBI at their training facility in Glencoe, Georgia.) In a memorandum dated August 30, 1982 to the Western Region field director of law enforcement operations, then regional director of the National Park Service, Howard Chapman, wrote, "Except in cases that are clearly malicious, willful, or deliberate acts, violations of regulations by visitors may be initially assumed to have occurred because of inadvertance, lack of understanding or misinformation. Enforcement activity shall have education and information as a primary objective as a means of gaining voluntary

compliance with rules and regulations."⁴

Compliance is the aim. Education is the primary method for achieving that goal. However, it would be naive to suppose that reality always matches the ideal. Mindful violations do occur within our refuges, forests and parks. Hopefully, enforcement of laws and regulations serves as an education, not just a punishment, to those who willfully transgress.

Preservation of wild lands and creatures is a general goal with education and enforcement serving as tools for resource protection agencies. What, then, are the specific objectives of wildlife laws and regulations? Robert H. Giles, Jr. has proposed the following objectives in his text entitled Wildlife Management:

1. "To prevent wildlife populations, particularly endangered, migratory, and breeding populations, from becoming exterminated in an area.
2. "To protect the ecological health of habitats, especially from conflicts of land users.
3. "To maximize the opportunities of all citizens to ~~experience~~ experience benefits from wildlife. (Includes the areas of recreation and visitor safety)
4. "To regulate the rate of exploitation of wildlife populations.
5. "To assure that desired, calculated harvests are achieved.
6. "To assure each licensed person an equal opportunity to pursue fish or game. (In areas where applicable)
7. "To balance the allocation of the resource to the users, properly weighing special group interest and influence (e.g. hunting clubs, anti-hunting lobbies), preventing exploitative groups from forming, and minimizing private interests' preying on the public 'capital.'
8. "To ensure stable agency income, consistent with agency objectives, by encouraging the user to pay through licenses and fees."⁵

Giles says that in order for those objectives to be practicable, the laws which apply must meet the following criteria:

1. "A need for a law must be clear to the public and to resource managers and should express long-term benefits.
2. "The intent of the law must be explicit and must order some particular action or prevent some particular action.
3. "The law must be directed at ensuring the existence of a species at or above all minimum thresholds for survival. (This also provides for habitat protection.)
4. "Laws must not be enacted without prior input from the public."⁶

History

The earliest form of wildlife law enforcement dates back to the 7th century Frankish monarchs in the region of Europe where Germany and Austria now exist. The monarchs appointed guards to protect their private forests so that serfs would not hunt in them. Game animals in those forests were considered private property of the monarch. The same system applied in Britain. In 1215, King John signed the Magna Carta, which limited the king's authority, gave more rights to the commoners, and instituted the tradition of common law. In 1225, King Henry III signed the Forest Charter, which decreed that no one was to lose life or limb for killing the king's deer, but would suffer a "greivious fine" if he had money, or would be imprisoned for a year and a day if he had no money. On continental Europe, commoners would not limit the control of their rulers until the revolutions of the 18th and 19th centuries.⁷ The right to hunt in many parts of Europe is still determined by property ownership.

On the North American continent, native people had lived in harmony with their environment for ages. The concept of property was unknown. Animals were **seen as partners in the great circle** and the hunters killed only what was necessary to provide food, clothing and shelter for their people. The symbiotic relationship between man and animals was best expressed by Chief Sealath(Seattle), who said, "What is man without the beasts? If all the beasts were gone, men would die from great loneliness of spirit, for whatever happens to the beasts also happens to the man."⁸

Early American colonists brought their European concepts of property ownership and landowner's rights with them. Hunting privileges were granted to settlers in documents like the Massachusetts Bay Colonial Ordinance of 1647 and the New Jersey Concessions of Agreement of 1678. Wildlife outside of settled land was considered fair game and thus began the egregious killing of North American

wildlife populations. Europeans did not share the native people's sensibility about interrelationships of all creatures. Trappers took as many pelts as they could, for trade on the foreign market was lucrative. Russian trappers along the West Coast brought the sea otter population to near extinction. The most illustrative example of settlement impacting wildlife populations in America would be that of the plains bison. In 1865, the plains tribes of the Sioux, Cheyennes, Apaches and others lived nomadically following the great herds of bison estimated to number 15 million head. By the late 1870s, bounty hunters in the employ of the developing railroad companies brought that number to under 1,000 head. (This action was encouraged by the army and the Bureau of Indian Affairs in an underhanded attempt to move the tribes onto reservations.)⁹

As wilderness shrunk, enlightened people like John Muir and Cornelius Hedges championed the cause of conservation. Hedges, part of an exploration expedition in Wyoming and Montana in 1870, lobbied for the establishment of Yellowstone National Park, which was achieved in 1872. Muir, through his writings and his founding of the Sierra Club in 1892, was able to influence the growth of conservation awareness.

The popular recognition of the environment's intrinsic value gave birth to resource management in America. This led to the development of modern wildlife law enforcement. Instead of protecting property owners' and hunters' rights, the intent of wildlife law became directed toward wildlife and habitat enhancement and management. Florida's Pelican Island was set aside as a refuge in 1903 with the protection of threatened heron and egret populations as its function. Today, the United States Fish and Wildlife Service manages over 400 National Wildlife Refuges consisting of 90 million acres for the purpose of protecting what we as a society have not already destroyed.

On the federal level, agents of the U.S. Fish and Wildlife Service protect wildlife through the enforcement of laws such as the Lacey Act of 1900, which regulates interstate and international commerce in wildlife, the Migratory Bird

Conservation Act, which gives the director of the Fish and Wildlife Service the authority to set bag limits or call for the moratorium concerning the hunting of waterfowl, and the Endangered Species Act of 1973.

Regulatory authority of the California Department of Fish and Game became law in 1933 as part of the California State Penal Code. That authority was broadened by amendments in 1957 and 1976. Wardens enforce provisions of the penal code contained in the Fish and Game Articles, such as Division 3, Chapter 1, §2000, addressing the unlawful taking or possession of fish and wildlife. Division 3, Chapter 1.5, §2050-2055 provides for the protection of endangered species.

Basis of Authority and Jurisdiction

Federal

The United States Constitution provides for the division of power between the federal and state governments. Federal powers are cited in Article I, section 8 of the Constitution. Powers not specifically delegated in the Constitution reside with the states. Wildlife is not specified, so the states have jurisdiction over most wildlife matters. However, Title 16 of the United States Code contains congressional enactments creating and empowering conservation agencies, defining laws and granting regulatory authority. As a result, states do have jurisdiction over most wildlife matters except on federal land and in matters involving migratory or endangered species.

Title 16 U.S.C., Chapter 9 defines the organization, function and authority of the United States Fish and Wildlife Service (the agency which administers National Wildlife Refuges). This chapter authorizes the Secretary of the Interior (U.S.F.W.S. is within the Dept. of the Interior) to empower trained Service personnel with law enforcement commissions:

"The Secretary of the Interior shall enforce the provisions of this section

and shall promulgate such regulations as he deems necessary and appropriate to carry out such enforcement. Any employee authorized by the Secretary of the Interior to enforce the provisions of this section may, without warrant, arrest any person committing in his presence or view a violation of this section or of any regulation issued hereunder ...and may execute any warrant or other process issued by an officer or court of competent jurisdiction for the enforcement of the provisions of this section." [16 U.S.C. 9, §742j(d)]

The proposed Laguna de Santa Rosa National Wildlife Refuge would be managed under further provisions of the National Wildlife Refuge Act of 1966. These provisions are spelled out in Title 16 U.S.C., Chapter 8, §668dd regarding access to areas for hunting, fishing and recreation and the enforcement of regulations:

"The Secretary is authorized under such regulations as he may prescribe, to (a) permit the use of any area within the System for any purpose, including but not limited to hunting, fishing, public recreation and accommodations, and access whenever he determines that such uses are compatible with the major purposes for which such areas were established... (e) Any person who violates or fails to comply with any of the provisions of this Act or any regulations issued thereunder shall be fined not more than \$500 or be imprisoned not more than six months, or both. (f) Any person authorized by the Secretary of the Interior to enforce the provisions of this Act or any regulations thereunder, may, without a warrant, arrest any person violating this Act or regulations in his presence or view, and may execute any warrant or other process issued by an officer of competent jurisdiction to enforce provisions of this Act or regulations, and may with a search warrant search for and seize any property, fish, bird, mammal, or other wild vertebrate or invertebrate animals or part or nest or egg thereof, taken or possessed in violation of this Act or the regulations issued thereunder." [16 U.S.C. 8, §668dd-ee]

In addition to enforcing conservation laws codified in Title 16 of the United States Code, Fish and Wildlife enforcement personnel enforce the regulations referred to in Title 16, which are found in Title 50 of the Code of Federal Regulations. These regulations are often specific to certain refuges, are submitted by refuge managers who see the need for these regulations, are printed in the federal register and, in most cases, if there is not much reasonable opposition to the proposed rules, the Secretary of the Interior approves them for inclusion in the Code of Federal Regulations.

Refuge specific regulations should play an important role in the restoration effort of the Laguna de Santa Rosa, as I will discuss in my conclusions.

Enforcement rangers of the United States Fish and Wildlife Service also have the authority to make arrests, searches and seizures for laws included in Title 18 of the United States Code, the Federal Criminal Code, and Title 21 of the United States Code, which pertains to drugs.

There are three types of federal jurisdiction: exclusive, concurrent and proprietary. National Wildlife Refuges commonly fall under proprietary jurisdiction, meaning the federal government owns the land and its agents enforce only federal laws and regulations. They may not enforce Title 18, Chapter 13 of the United States Code, the Assimilated Crimes Act, however. The Assimilated Crimes Act incorporates state laws not included in the Federal Criminal Code, like burglary or concealed weapons, enabling federal officers to make arrests for such charges. In areas of proprietary jurisdiction, state officers have the authority to enforce state laws and regulations on federal land by agreement. Areas under proprietary jurisdiction may incorporate state hunting and fishing regulations and the state vehicle code into Title 50 of the Code of Federal Regulations, but violations will only be treated as petty offenses in that case, whereas states often have stricter penalties for hunting and fishing violations. In areas of concurrent jurisdiction, state and federal agencies share authority with the state handling all state matters and the federal government handling federal matters. The federal government may enforce state laws by way of their inclusion into federal law under the Assimilated Crimes Act.¹⁰

State

Regulatory and enforcement authority for the California Department of Fish and Game is based in the Fish and Game Articles of the California State Code adopted May 21, 1957, repealing and reenacting the 1933 Fish and Game

code. Division I, Chapter 2, §200 states:

"There is hereby delegated to the commission the power to regulate the taking or possession of birds, mammals, fish, amphibia, and reptiles to the extent and in the manner prescribed in this article."

Division I, Chapter 2, §202:

"The Commission shall exercise its powers under this article by regulations made and promulgated pursuant to this article."

Enforcement authority for wardens of CDF&G is to be found in the following two paragraphs of Division II, Chapter 2:

"A deputy appointed to enforce the provisions of this code is a peace officer. He has all the powers and authority conferred by law upon peace officers listed in Section 830.3 of the Penal Code to make arrests for violations of this code and may serve all processes and notices throughout the state." [Div. II, Ch. 2, §851]

"The county fish and game warden shall enforce the state laws relating to the protection of fish and game. He has the power and authority conferred by law upon peace officers listed in Section 830.3 of the Penal Code." [Div. II, Ch. 2, §878]

As mentioned earlier, the Laguna Advisory Committee has recommended that the California Department of Fish and Game manage the proposed national wildlife refuge for its owners, the U.S. Fish and Wildlife Service. This would be a unique endeavor, as no such arrangement now exists in the National Wildlife Refuge System. Current logistics seem to indicate that this is a sensible arrangement in light of budget constraints on the federal level. C.D.F.&G. has an established presence in Sonoma County, whereas the closest U.S. Fish and Wildlife Service personnel are based at San Francisco Bay National Wildlife Refuge, 80 miles south of the Laguna de Santa Rosa. Furthermore, C.D.F.&G. owns land in the Laguna de Santa Rosa and has conducted research in the area already.

When I began this project, I felt that such an arrangement as proposed by the Laguna Advisory Committee would pose problems for law enforcement. I found, however, that the concurrent and proprietary systems of jurisdiction would allow California Department of Fish and Game wardens to enforce state

laws and regulations on refuge land by agreement with the United States Fish and Wildlife Service.

My research enabled me to find a provision of Title 16 of the United States Code that could further uncomplicate any jurisdictional confusion. This legislation authorizes the Secretary of the Interior to, in essence, deputize state agents for the enforcement of federal laws. Title 16 U.S.C. Chapter 9, §7421, The Law Enforcement Cooperative Agreement Act states:

"Notwithstanding any other provision of law, the Secretary of the Interior and the Secretary of Commerce may each utilize by agreement, with or without reimbursement, the personnel, services and facilities of any other Federal or State agency to the extent he deems it necessary and appropriate for effective enforcement of any Federal or State laws on lands, waters or interest therein under his jurisdiction which are administered for fish and wildlife purposes and for enforcement of any law administered by him relating to fish and wildlife."

Summary and Conclusions

My research has fortified my belief that wildlife law enforcement is one of the most important functions of any resource management agency. It is based on educating the public about the need for respect of our natural wildlife and habitat legacy. Voluntary compliance is its aim. In those unfortunate incidents which demand stricter measures, enforcement seeks to gain future compliance from transgressors by treating them strictly but fairly and demonstrating the seriousness of resource management's mission.

Regarding the Laguna de Santa Rosa, I feel that refuge specific regulations limiting access to the fledgling refuge to an absolute minimum will be necessary in order for restoration efforts to succeed. Upland oak habitat and riparian areas will need special attention, as they are most sensitive to intrusion. Any grazing which still exists in the Laguna area will need to be strictly controlled. I anticipate that hunting on the young refuge, if permitted at all, will be minimal in scope. Increased access to the more sensitive and

impacted areas should not be permitted until the stability of those areas can be assured.

Close cooperation between enforcement personnel and the community will be necessary throughout the existence of the refuge, but will be especially vital in the early stages of operation. I hope that an informational facility will be built which will provide the public with a place to go to learn about the restoration effort. The people will need to know that access to this public land is being limited for an important reason.

There exists a confusion about the difference between "parks" and "refuges." I hear it all the time at the refuge where I work. People want to know where they can go for a "drive-through tour" or where the concessions are or when the nature walks are scheduled. National Parks are directed at sharing the outdoor experience with people. Refuges are too, but to a much lesser extent. Many refuges do not even have any kind of visitor facilities. People should understand that the Fish and Wildlife Service's primary function is to maintain habitat and healthy wildlife populations. Any development of refuges for recreational purposes is of secondary importance. According to Title 16 U.S.C., Chapter 8, §668dd, the Secretary of the Interior need only permit recreational opportunities within National Wildlife Refuges if he deems that "such uses are compatible with the major purposes for which such areas were established."

While I do not foresee any law enforcement complications regarding jurisdiction for the reasons stated earlier, I do feel that the U.S. Fish and Wildlife Service will eventually need to take over management of the Laguna de Santa Rosa National Wildlife Refuge. Their only other option would be to transfer the land to the California Department of Fish and Game once the desired stability of the area is achieved. I feel that differences between the state and federal government would be inevitable on certain matters.

Such matters can be worked out in the future. The most important matter now is saving the Laguna.

Research

I began my research by consulting texts on wildlife law enforcement and wildlife management. The most useful texts were William F. Sigler's Wildlife Law Enforcement and Robert H. Giles, Jr.'s Wildlife Management.

Next, I consulted Ralph Mihan, solicitor for the Department of the Interior in San Francisco. Mr. Mihan provided me with a wealth of information on authority and jurisdiction. He also directed me to the proper areas of U.S. Law for the next part of my research.

Some feel that law is dry and hard to swallow. I found it very palatable. Reading the Titles of U.S. Codes and the Code of Federal Regulations was my favorite part of the research. I was interested in seeing how every facet of a government agency such as the U.S. Fish and Wildlife Service is addressed in law. I also consulted the California Penal Code for information concerning the California Department of Fish and Game.

Finally, I talked with Daniel Doshier, refuge manager of Kenai National Wildlife Refuge in Alaska. He discussed the philosophy and function of the U.S. Fish and Wildlife Service and the National Wildlife Refuge System. He also stressed the importance of maintaining open lines of communication with the surrounding community.

Recommendations for Future Study

I recommend to anyone pursuing the subject of wildlife law enforcement as it pertains to the Laguna de Santa Rosa to examine specific regulations which could be implemented to facilitate the restoration process. Another direction to follow might be a survey of the amount of hunting pressure currently in the area or perhaps a survey of local people's attitudes about restricted access to the refuge for the first few years of its existence.

"We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect."

-Aldo Leopold
from the foreword to A Sand County Almanac

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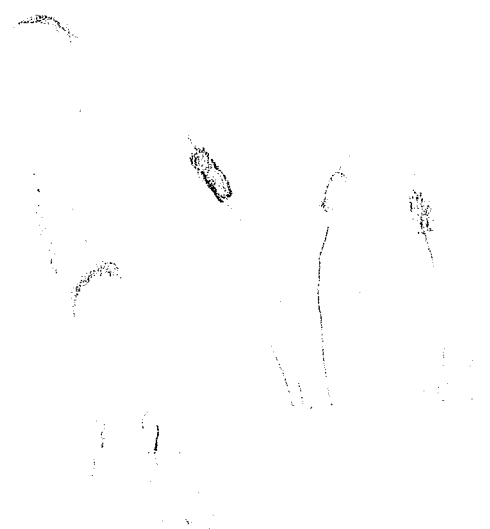
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Interview with Ralph Mihan, solicitor, Western Region, United States Department of the Interior, San Francisco.



RESTORATION PLANS
FOR VARIOUS HABITATS OF THE
LAGUNA DE SANTA ROSA

BY

Denise J. Francisco

-As the warming glow of the rising sun fills the eastern sky, the golden grasses of the Laguna de Santa Rosa begin to sway with the first mornings breath. The breeze carries the scent of the still damp earth and the light fragrances of wild flowers and native grasses. The massive valley oak, so strong and magnificent, appears delicate and lacey against the light eastern sky. As the daylight grows brighter, a myriad of bird and animal life stirs, awakening to the new day. The grasses, trees, and sky are filled with the sounds and activities of birds as they go about their daily tasks. Various mammals stalk the grassy oak savannah in search of their first days' meal.

This morning ritual occurs daily, and is often not noticed by even the most observant of people. People are often so busy, preoccupied by their own daily struggles, that they fail to see the simplicity and beauty of nature's daily awakening. The time has come, however, for people to start noticing the existence of nature that surrounds them. When California became a state in 1850, there were 5 million acres of wetlands. (5) In 1982, only 450,000 acres of wetlands existed; a reduction by 91%. (5) We have a unique opportunity in

2

Sonoma County to protect a truly remarkable wetland resource-the Laguna de Santa Rosa. In preserving this area, we can allow future generations to revel in the awakening of nature's days.

Preserving the existing resources of the Laguna may not be enough. Acquisition of existing wetlands and former wetland areas, along with regulation in support of public policy, and wetland enhancement through rehabilitation or restoration appear to be the most reliable solutions to the problem. (5) The Laguna's natural resources are currently endangered by urban sprawl, pollution, and agricultural practices.

Restoration of a particular species of tree or an acre of native grasses is a complex task, one currently in trial stages in other areas. A restoration plan should consider the following: having knowledge of the biological and ecological requirements of the species to be restored, choosing the size of the area to be restored, negotiating compatible land uses, and planning for a long-term or permanent protection of the restored species. (4) Appropriate monitoring measures of the restoration activities should be included to provide a status report on the restored species to guide further restoration actions if needed. The areas of restoration discussed in this paper associated with the Laguna de Santa Rosa include: oak woodlands, oak savannahs, grasslands, and vernal pools.

Existing Laguna Ecosystems and Restoration Plans

The oak woodlands are dominated by oaks, including black oaks (*Quercus kelloggii*), white oaks (*Quercus garryana*), and coast live oaks (*Quercus agrifolia*). This area is also characterized by a variety of broadleaf trees such as bays, and deciduous trees such as buckeyes. This plant community prefers the higher elevations of the Laguna area characterized by drier conditions. (2) Due to the large

diversity of plant and tree species, this area affords greater protection of many types of birds and mammals. It is necessary to protect these areas and enhance their growth to encourage bird and mammal species to remain as their inhabitants. This particular ecosystem of the Laguna area seems to be fairly healthy, with no immediate signs for the potential endangerment of plant species or total loss of habitat. There are problems effecting this habitat such as urban sprawl and clearance of growth for agricultural practices. Restoration of this habitat is not as crucial as just protecting the already existing oak woodlands, which due to its greater diversity of species could have a significant recovery on its own. If restoration of this area is considered, the following measures are to insure the survival of the oak woodlands.

Oak Woodlands Restoration Measures

- * Promote increased protection of existing oak woodlands habitat by changing the existing zoning-convert private lands to public ie. wildlife refuge
- * Conduct inventory process of existing species making special note of any decrease in any species
- * From inventory, replant any diminished species at a 2:1 ratio particularly focusing on the oaks
- * Provide adequate water and nutrients to seedlings for first two years of growth
- * Provide adequate protective fencing for seedlings first two years

The next area to focus restoration actions upon is the oak savannahs. Oak savannahs, noted for their grasslands or meadows with valley oaks (*Quercus lobata*) widely dispersed throughout, are rapidly becoming an endangered plant community. (2) The magnificent valley oak is approaching the status of an endangered species and loss of the species is occurring all over the state of California. The seemingly virile valley oaks are actually quite sensitive and can tolerate only a minimal amount of disturbance in their natural habitat. The problems currently effecting the oak savannah habitat of the Laguna area are overwatering, overgrazing, agricultural practices, and competition from non-native grasses.

During the summer months, farmers along the Laguna use reclaimed wastewater to spray their lands to irrigate their crops.

Unfortunately, the valley oaks do not require summer watering and this promotes the growth of a fungus which eventually causes the oaks to rot and die. Use of summer irrigation also promotes the growth of non-native annual grasses. These grasses overcome the young oak seedlings, smothering them completely. Overgrazing and trampling by dairy cattle, horses, and deer destroy any young oak seedlings as they begin to grow. Other agricultural practices, such as discing, mowing, and soil compaction near the roots of the valley oaks are rapidly diminishing the strength of the existing oaks. Immediate restoration actions are necessary to protect the future of the valley oaks.

Oak Savannah Restoration Measures

- * Avoid irrigation, discing, mowing, or soil compaction within 75 foot perimeter of any valley oak
- * Avoid changing contour of land around existing oaks
- * Monitor irrigation practices of farmers
- * Monitor discing and mowing activities of farmers
- * Periodic removal of dead wood from existing mature oaks by experts (3)
- * Plant three seedlings for every stump, snag, and existing oak on public lands
- * Provide protective wire cages for first two years growth
- * Provide adequate water and nutrients for first two years of growth
- * After two years, provide adequate fencing to keep herbivores from damaging young trees
- * Monitor growth and fencing requirements for a total of five years
- * For every seedling that fails, replant two new seedlings
- * Consider the Laguna area as an off-site mitigation measures area for future developments that are to occur in Santa Rosa and Sebastopol which result in a loss of some type of valued habitat

The sister community to the oak savannah is the grasslands dominated by grasses. The grasslands area of the Laguna was once flourishing with native perennials and is now dominated by highly competitive annuals which were introduced by the Europeans. (2) The continuation of summer irrigation only encourages the growth of the non-native species, as most of the native grass species are drought tolerant and require no summer watering. Rehabilitating a grasslands area is difficult due to the competition from non-native species and

the wide variety of native species that need to be reestablished. As a proposal, an entire area of the Laguna de Santa Rosa grasslands should be set aside for removal of all non-native species and revegetating the area entirely with native species should be considered. This would have to be undertaken in a suitable location and monitored regularly. Setting such an area aside would prove to be extremely valuable, as areas devoid of non-native species are quite rare and rapidly diminishing.

Grasslands Restoration Measures

- * Prohibit grazing or foot travel in proposed total grasslands restoration area
- * Promote compatible land uses in other grasslands areas ie. grazing permits allowing grazing only certain times of the year for certain lengths of time
- * Promote direct removal of non-native grasses on public lands
- * Discourage spray irrigation in areas of native grasses
- * Give private landowners incentives to revegetate area with native grasses ie. give a longer length of time on grazing permit

The last ecosystem of the Laguna deserving a restoration plan is certainly one of the most endangered and controversial of all ecosystems the vernal pools. California, Sonoma County in particular, has the distinction of having the extremely fragile vernal pools ecosystems which appear here and nowhere else in the United States. Vernal pools have become an area of local and statewide concern much to the dismay of many developers! Vast numbers of these specialized ecosystems are being lost to urban development, being plowed under, or trampled by cattle. Though some agricultural uses may be compatible, such as grazing because the cattle prefer the non-native grasses surrounding the vernal pools, most uses severely damage or destroy the fragile areas of wildflowers. (1) According to recent efforts, moving and relocating a vernal pool and its plant species is not highly successful. The vernal pools are an extremely complex and sensitive ecosystem and the conditions under which they exist are difficult to duplicate. It is extremely important for the vernal pools in the Laguna area to be restored and maintained, because

they are the most threatened of California's wetland types. (5)

Vernal Pools Restoration Measures

- * Map out existing vernal pools
- * Protective zoning to preserve existing vernal pools
- * Promote minimal disturbance during wet season
- * On private lands, promote fencing around vernal pools especially during the wet season
- * On public lands, discontinue grazing permits during wet season
- * Increase public awareness of vernal pools
- * Encourage public pressure to preserve these areas

Summary and Conclusions

As has been shown above, the Laguna de Santa Rosa has many unique and diverse ecosystems worth preserving and enhancing through restoration. The oak woodlands with its variety of oaks, deciduous and evergreen trees. The oak savannah dominated by the powerful, yet sensitive and diminishing, valley oak. The grasslands once home to the native grasses now overgrown with non-native species. And, the vernal pools, small, beautiful, and fragile areas with a large significance. All of these areas are contained in one unique wetland area-the Laguna de Santa Rosa.

There is a necessity to make the public aware of this great natural resource. One source of recent information used in this paper, The California Wetland-An Element of the California Outdoor Planning Programs, focused mainly on acquiring and preserving wetlands and their associated threatened habitats such as vernal pools, riparian zones, and oak habitats. This extensive report, however, did not acknowledge that any wetlands and threatened habitats existed in the Laguna area or even in Sonoma County! It is important that Sonoma County and the Laguna area be reconized for having threatened wetlands and other ecosystems. With such a valuable wetland resource in our backyard and the fact that wetlands and their associated habitats are diminishing, we cannot become complacent and preoccupied to the point where one day we look and the Laguna has become filled with

subdivisions, industrial parks, and roads. It has become clear through my research that many people do not know of the significance of the Laguna and how to go about actually preserving and enhancing successfully such an area. It is my hope that these goals of informing the public and preserving and restoring the Laguna de Santa Rosa and its associated habitats to a pristine state can be achieved for us, future generations to come, and the many plant and animal species that live and depend on the Laguna de Santa Rosa for their continued survival.

-The patchy clouds drift by from the south, as the sun dips behind the western hills. In the early twilight, the dwindling light causes the clouds to burst into fiery pinks, oranges, and reds. Followed next by lavenders, grey, and finally slate. The sound of wings beating a furious path home to a comforting nest before the darkness completely closes in interrupts the hush of dusk. The grasses begin to come alive again, this time with the wanderings of the nocturnal animals. The hooting of a distant owl confirms to all that indeed another night has come. The first star appears, twinkling, its reflection cast upon the waters of the Laguna de Santa Rosa.

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Is it a Vernal Pool?

by Roneal Gardner

Introduction

Are the pools on our property vernal pools or just seasonal wetlands with interesting flowers in and around them? I found in researching the answer to this question that there is much literature available on the many specialized aspects of vernal pool ecosystems. Through my research, I also became aware that this important habitat within the Laguna wetlands is legally disappearing from the Santa Rosa Plains even though there are rare and endangered species of plants typically associated with vernal pools. It is my belief that if people are able to understand and recognize what a vernal pool is, why they are worth preserving and understand why and how they are disappearing, that they will be more open and vocal about preserving this valuable aspect of the Laguna wetland system.

Sources of Information

I gathered my information from reading articles on vernal pools, conversations with local experts on vernal pools, actually visiting several vernal pool sites, attending a Public Hearing sponsored by the League of Women Voters and a symposium put on by the California Native Plant Society. The focus of my project was to create a clear easy-to-follow guide that would help people recognize, appreciate, and want to preserve our remaining Santa Rosa Plain vernal pool systems.

How to Recognize a Vernal Pool

Vernal pools^{of advanced development} are a wetland habitat endemic to California. The vernal pools associated with the Santa Rosa Plains are typically found in open fields of uneven topography. The pools are generally located in shallow depressions and are characterized by standing water in the winter rainy season and early spring, drying up

completely by early to mid-summer. A majority of the pools are quite small but some can be very large in area.(1) The progressive evaporation of the pool concentrates the remaining water resulting in higher alkalinities and salinities in the waters at the pool center than on the periphery. This progressively declining water table causes individual plant species to specialize to the various combinations of soil moisture, temperature, and alkalinity that occur at the pools edge.(1) This causes the progressive growth of rings of flowers at the pools receding rim.(1) These brightly colored rings of flowers surrounding the vernal pools are their most obvious visible characteristic. Most species of vernal pool plants, 91%, are endemic to California and several are endemic to Sonoma County.(2,3) Five species of ^{vernal pool} plants are listed as rare or endangered in California. The plants associated with vernal pools grow in three zones. Zone one corresponds roughly to the pool bottom, zone two occurs around the margins of the pool and zone three occurs on the higher better drained rim of the pool.(4) The flowers of zone three are predominantly yellow in color. The flowers associated with zone two are predominately yellow ²⁵ and white. The flowers of zone one are usually beautiful shades of blue and or green. Once these have dried up you are left with a dead spot in the grassland as the soil alkalinity and salinity discourages the growth of invader species.(5) see appendix #1

How Vernal Pools are Protected

No California vernal pool plant or fauna species are as yet listed on the Federal Endangered Species list and so the federal government plays a very small role in their protection. The only

time the federal government would actively get involved with their protection is if a particular pool system was a stop over spot for a migratory waterfowl that is on the Endangered Species List. Several plant species are currently candidates for federal protection. (3) see appendix #2

No federal listing means state laws are the most important source of protection for vernal pools. There are three laws providing protection in our state. These are The Native Plant Protection Act (NPPA), The California Endangered Species Act (CESA), and The California Environmental Quality Act (CEQA). The NPPA directs the California Department of Fish and Game (CDFG) to "pre-serve, protect, and enhance endangered plants of this State." NPPA has provisions that prohibit the "taking" of rare or endangered plants from the wild and a salvage requirement for landowners. The CESA expands upon but does not replace the NPPA. It created a "threatened" category of species. It also adds state agency consultation procedures that discourage the approval of projects under CESA that would "jeopardize" endangered or threatened species. CEQA requires assessment of the project's impact on the biological communities as well as traffic, schools, air quality etc.. The agency of responsibility for the initial environmental report is the planning department. If the initial study reveals that a project may "reduce the number or restrict the range of rare or endangered plants" it is to be considered significant enough to require an Environmental Impact Report (EIR) or a mitigated Negative Declaration. Through consultation with the CDFG alteration of the project design or mitigation measures are developed to compensate for the loss of rare species. Another alternative is that the lead agency may

adopt a "statement of overriding concern" which states that the benefits of the project outweighs the adverse environmental impacts.(6)

Within the framework of these three laws are loop holes big enough to make the CDFG's job of protecting and preserving the vernal pools almost impossible.(7,8)

In Sonoma County a developer is required to follow set procedures for approval of his project. He must go to the U.S. Corps of Engineers who have jurisdiction over wetlands to get their approval. If there is less than an acre of wetlands and no endangered species they may issue a blanket permit allowing the development. If there is ten acres of wetlands involved or endangered species present the Corps will step into the protection process. The developer next goes to the Santa Rosa Planning Department if it is within the city limits or to the Sonoma County Planning Department if it is in the unincorporated areas of the county to apply for a use permit. If the developer wants to save time he can be applying to both the Corps and the planning commission at the same time. Before a use permit is issued, the appropriate planning commission will send a referral to the CDFG, ^{CNPS and others} and ask for comments on the project. The CDFG then prepares their response to the referral and returns their response to the planning department. It is at this point that a EIR can be asked for. The planning department then tries to balance the concerns of all concerned and then either approve or disapprove the project based on their findings. At this point if either the developer or CDFG is unhappy with the results, they can take the issue before the city council for issues within city limits or before the County Board of Supervisors for issues outside city limits. If either party is unhappy with this decision then

the next step is a lawsuit.(9,10)

In response to the rapid disappearance of our counties vernal pools the CDFG paid for a detailed report on the vernal pools of the Santa Rosa Plains, their location and species diversity and distribution. Once the best sites have been determined, these will be set aside for preservation. Developers who want to build on land with less significant vernal pool sites will be asked to pay a one time fee to help maintain and protect the preserved sites. If a developer's site contains a significant vernal pool site they may be asked to set aside a preserve.(11) Documentation of sites is one of the first steps in getting adequate protection. Continued study and documentation will be needed to provide a factual basis for administrative and legislative decisions.(12)

The Sonoma County Board of Supervisors and city councils need to be sympathetic to the environmental issues and willing to use their rights to interpret state laws in a protective mode rather than in a prodevelopment mode. (8)

Information needs to be disseminated to the general public through national magazine articles and pictorial histories of vernal pool development in a season.(12)

Vigorous enforcement of existing laws and regulations also needs to take place. Once our endangered species are officially listed on the U.S. Fish and Wildlife Service list, funds are opened up for the purchase of lands and the setting up of wildflower preserves.

Why Protect Vernal Pools?

The wide distribution and high level of development of our California vernal pools occurs nowhere else in the world. There

is a high percentage, 91%, of endemic biota in the vernal pool habitat. There are very few non-native plants that can survive these extremely specialized habitats. They are perhaps the most pristine habitats in California.(13)

The presence of rare species is typically associated with vernal pools. The arguments that apply to saving any endangered species also apply to vernal pool species even though they be less lovable than a spotted owl or white seal pup. The distribution of rare vernal pool plants tends to be random.(13)

Vernal pool are especially vulnerable to habitat destruction because they occur mainly on flat easily developed pieces of land.(13)

They provide **valuable** study sites for researchers. Ecosystems can be identified and defined and the limited size of the system will allow a more exact and complete study than possible with larger systems. Vernal pool populations are useful in population biology studies because they are distinct and easy to identify and because there ~~may be~~^a high degree of variability between populations.(13)

Vernal pools contain as yet many undiscovered secrets. The plants of vernal pools have a very efficient water use mechanism and because of their physiological adaptations to high salt conditions there is a potential for developing vernal pool species for agriculture. Similiar endeavors could be made for those species adapted to dry and alkaline conditions. One secret that is now being unlocked is that of the seeds of the Limnanthes, meadowfoam, which are a source of oil whose properties make it a potential replacement for whale oil which is now illegal to import.(13)

Vernal pools during their short life cycle, 3-4 months, provide

on of the most colorful and eye pleasing floral masterpieces in nature. There is a special kind of peace and renewal of the spirit that comes to most people when they have viewed one of nature's masterpieces. This purely esthetic aspect should be considered as an excellent reason for protection.

Conclusion

It is my hope that this report has left you with a general understanding of what a vernal pool is and how to recognize one if you see it and to further appreciate why we need to protect and preserve these pools that help make Sonoma County unique and how we can help by being informed and vocal about their future.

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Appendix 1 (15, 16, 17)

Theraps associated with zone 3:

Rar

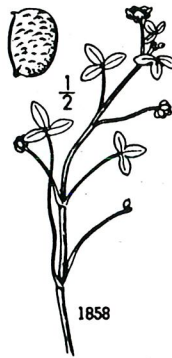
Rar

Buttercup

This in the actual pool. The floating leaves are of three
ob the submerged ones are threadlike. Flowers are white
wit The floating stems are up to three feet long.

LO States

Seen: Feb.- May



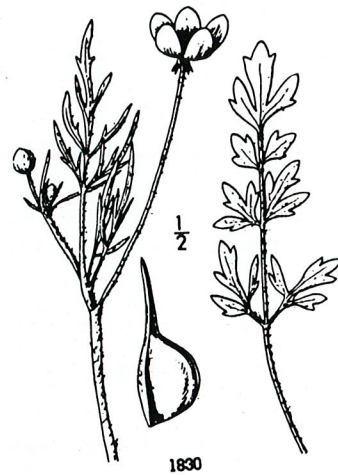
Ranunculaceae
 Ranunculus Orthorhynchus

Birdfoot buttercup

It is found on the outer perimeters of the pool. The leaves look alot like long thin birds feet. The flowers have five bright yellow petals. The seeds look like inverted bird's beak.

Located: Northern California
 Hieght: 1-1.5 dm.

Seen: April- May



Gramineae

Alopercurus aequalix

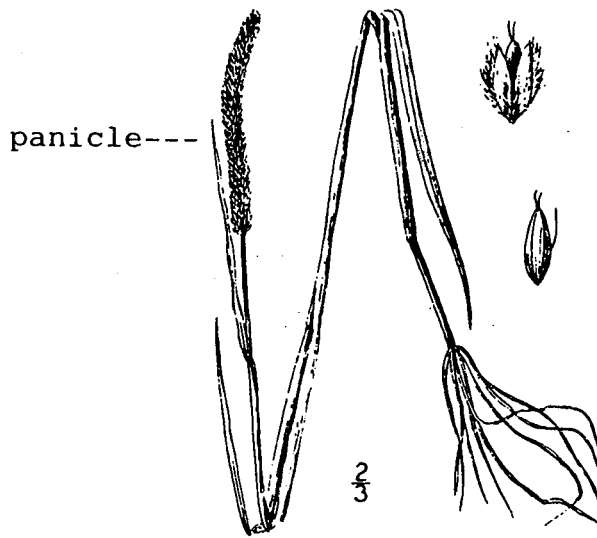
Little Meadow-Foxtail

It is a perennial grass with a flat blade like leaves and a soft dense spikelike panicles.

Located: Pacific States and cooler parts of North America

Height: 15-60 cm.

Seen: May- July



Umbelliferae

Eryngium armatum

Cyote-thistle

It has long narrow leaves with serrated leaf edges. The small spiked flowers are yellowish or on occasion blue in color.

Located: Central and Northern Calif. Seen: May- August

Height: .5-4 dm.



Leguminosae
Trifolium amoenum

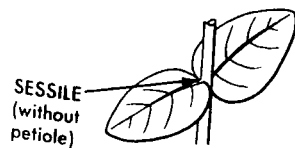
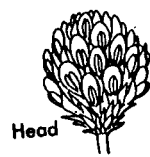
Showy Indian Clover

The stems are covered with fine hair. The leaves are nearly sessile. The head is a short ovoid on top of stem. The small tube shaped flowers are purple with white tips.

Located: Solano, Sonoma, Marin Counties Seen: April-June

Height: 1-6 dm.

Believed extinct

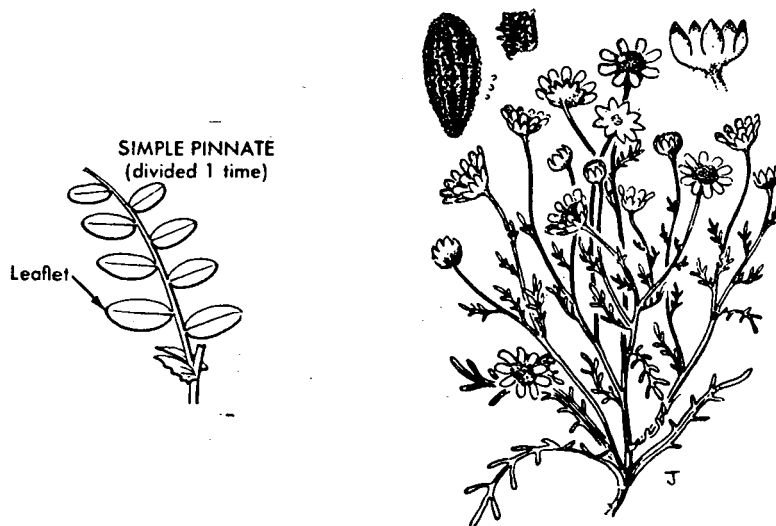


The dominant species associated with zone 2:

Compositae
Blennosperma nanum

A succulent herb, well branched stem and linear 2-3 lobed pinnate leaves. The oval flower head bracts are purple tipped with each tip having a tuft of hairs. The flowers are bright yellow, with yellow stigmas.

Located: Northwest coast of America Seen: March-April
Height: 8-20 cm.



Compositae
Blennosperma Bakeri

Baker's blennosperma

A succulent herb, well branched stem, linear entire or 2-3 lobed pinnate leaves. The oval flower head bracts are purple tipped with each tip having a tuft of hairs. The flowers are bright yellow, with maroon stigmas.

Located: Sonoma County
Height: up to 30 cm.

Seen: March-April



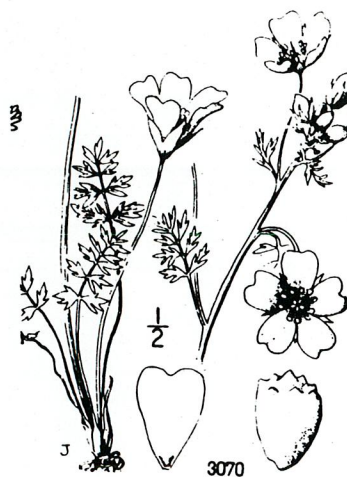
Limnanthaceae
Limnanthes douglasii

Douglas' Meadowfoam

The flowers are bell shaped with the inner portion yellow. Each petal has a u-shaped band of short hairs at the base of the inner surface. Each pinnate leaf is divided into 5-11 leaflets which may be entire or 3-5 toothed.

Located: Northern California
Height: 10-30 cm.

Seen: April-May



Limnanthaceae

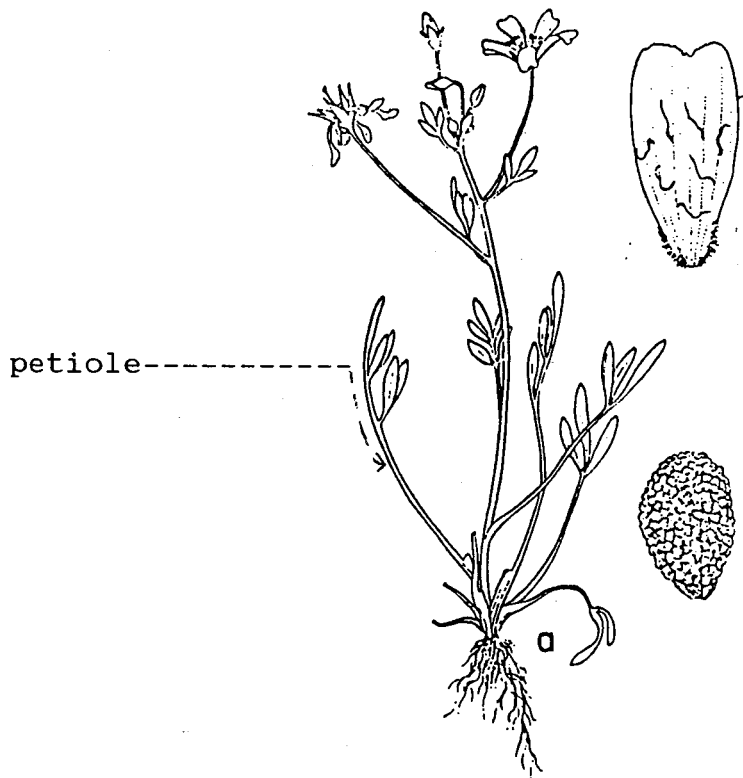
Limnanthes vinculans Ornduff

Sebastopol Meadowfoam or Cunningham
Marsh Meadowfoam

The flowers are bell shaped and white in color. Each petal has a u-shaped band of short hairs at the base of the inner surface. Each leaf is dissected, alternate, with long petioles.

Located: Sonoma County
Height: 5-30 cm.

Seen: April-May



Compositae
Lasthenia Burkei

Burke's goldfield

It is a somewhat succulent spring annual of the sunflower family. Its ray and disk like yellow flowers have the appearance of a miniature sunflower.

Located: sonoma County
Height: 8-20 cm.

Seen: April-May



The dominant species associated with zone 1:

Polemoniaceae
Navarretia prostrata

It is a prostrate annual with a spread of 8-15 cm. Its branches proliferate from beneath woolly or sticky flower heads. They have spiny leaves. The tiny flowers have five petals which range in color from white to violet. The stems are white.

Located: California

Seen: May-July



Polemoniaceae
Navarretia plieantha

many-flowered navarretia

It is a prostrate annual forming a spread of 5-20 cm. It broadens out with several stout branches but does not proliferate from beneath a central head. The flower heads have 20-50 flowers each.

Located: Northern California

Seen: June



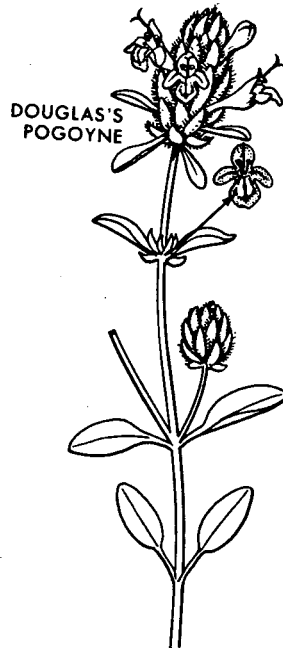
Labiatae
Pogogyne Douglasii

Mesa mint or Douglas' pogogyne

The flowers are in long dense oblong spikes at the end of a reddish stem. They are red-purple in color. The flowers are two lipped with a pale yellow spot on the lower lip. Leaves lance like. They grow in the dry bottoms of the pool beds. They have a pungent odor.

Located: Northern California
Height: 4-45 cm.

Seen: May-July



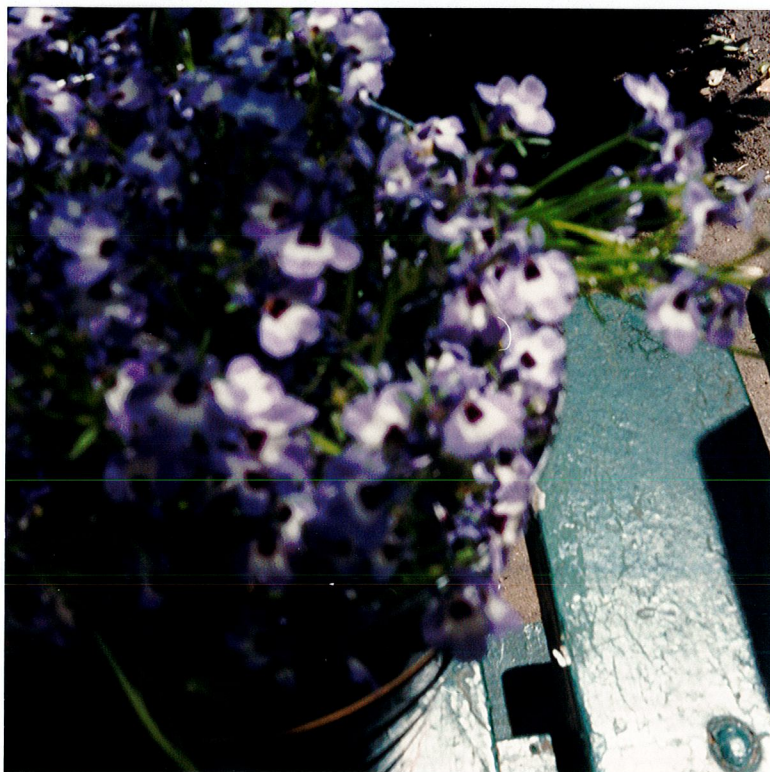
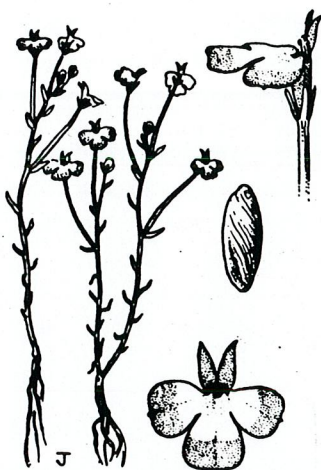
Campanulaceae
Downingia cuspidata

Toothed Downingia

The plants are very slender with the flowers only 1/2 inch across. The lower lip of the flower has three nearly equal lobes and the two upper ones are narrowly diverging. The flowers are bright or pale blue or lavender, the lower lip has a large central white area with a large yellow spot.

Located: California
Height: 6-25 cm.

Seen March-June



Appendix 2

Species listed as rare or endangered by the California Native Plant Society and/or by the Endangered Plant Program of the California Department of Fish and Game.

Listed by both:

Lasthenia Burkei	Burke's goldfield
Limnanthes vinculans	Sebastopol Meadowfoam or Cunningham Marsh Meadowfoam
Navarretia plieantha	many-flowered navarretia

Listed by the California Native Plant Society only:

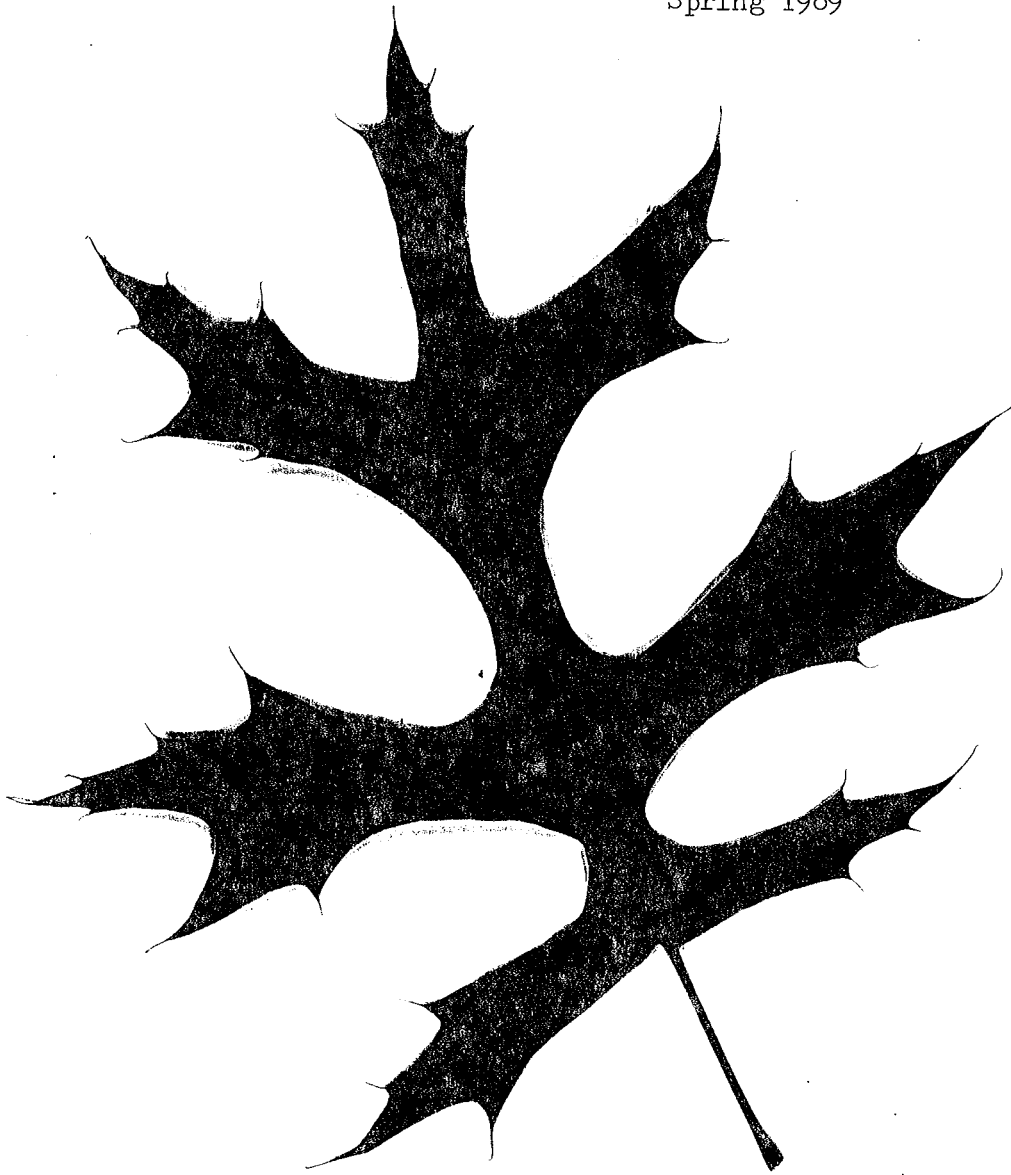
Blennosperma Bakeri	Baker's blennosperma
Pogogyne Douglasii ssp. parviflora	

RE-LEAF FOR THE LAGUNA DE SANTA ROSA

Brian Hildebidle

ENSP 321

Spring 1989



As a relative newcomer to Sonoma County, until last year I knew nothing of the Laguna de Santa Rosa. I became informed of the Laguna in the Fall of 1988 when some friends of mine were studying it for Dr. Merriman's group project. This spring, I became involved with the project and my introduction to the Laguna came near Occidental Rd. with Bob Sharpe. I noticed immediately the eroded banks of the streams and the lack of woody vegetation. Being a landscape gardener, I decided to investigate the possibilities and benefits of revegetating the Laguna.

In my research, I was surprised to discover the amount of recent literature on tree planting to absorb excess atmospheric carbon dioxide (CO₂). Carbon Dioxide is the major "greenhouse" gas thought to be contributing to global warming. Using this as a major benefit to revegetating the Laguna, I set out to see if any CO₂-related tree planting projects were in effect elsewhere, and should the Laguna receive National Wildlife Refuge status, who could do the actual planting.

The Greenhouse Effect and Trees

The decade of the 1980's has produced the six warmest years in the history of global temperature measuring (1). There has also been a dramatic increase in atmospheric CO₂ levels. From sections of the polar ice caps, scientists have determined that the pre-Industrial Revolution concentration of CO₂ in the atmosphere was 280 parts per million (ppm). Today that concentration is 345 ppm and rising at a rate of .4% annually (Fig. 1). It is estimated that contributing to 75% of the increase is the burning of fossil fuels, and 25% is due to

deforestation. Fixation of atmospheric CO₂ occurs during photosynthesis. Plants take CO₂ from the atmosphere, combine it with water from the soil using energy stored in the chloroplasts, and produce carbohydrates to form fibre (Fig. 2). Two events are occurring on opposite sides of the balance sheet on the earth today:

1. plants that absorbed CO₂ millions of years ago are now being burned as a fossil fuel and releasing the CO₂ back into the atmosphere
2. forests that usually fix enormous amounts of atmospheric CO₂ are being logged or burned. Burning directly releases more CO₂ into the atmosphere. (Fig. 3)

Because of its molecular structure, atmospheric CO₂ acts like the glass of a greenhouse: it lets solar radiation in, but it prevents the heat from radiating back into space. It is like leaving a closed car sitting in the July sun. Warmer temperatures due to the greenhouse could have catastrophic effects. Wetlands could get completely submerged by thermally expanding oceans, polluting groundwater supplies with salt. Desert conditions could spread and drought could severely hamper agriculture. Range of many native plant species would migrate north in the Northern Hemisphere; many species would become extinct. One study showed that habitats appropriate to beeches

will shift north 700 to 900 kilometers if current increases in CO2 continues (2).

Currently there is a lot of attention focused on tropical rainforest destruction; CO2 "sinks" are being denuded rapidly in these nations. The United States has also undergone enormous deforestation (Fig. 4). Today our industrialized society relies upon reams of paper to pass along information. Hardwood and mixed hardwood forests once extended from the Atlantic Ocean to the Mississippi River. Today, only 22% of those forests remain.

The Laguna de Santa Rosa

Needing a closer look to determine how much of the Laguna needed revegetation, I set out one morning by canoe with classmate, Drew Ibach. We launched our canoe into the murky waters at the Highway 12 overpass. The story of our trip to the Russian River reads like a chapter from Dante's Inferno. We encountered oily water, shopping carts, tires, oil barrels, snags, angry young bulls, barbed wire hung across the channel, mosquitoes, and green, eutrophic water. When we were finally rescued by a friend at Mirabel, she appeared as our guardian angel, returning us to a kinder, gentler environment.

We also encountered hundreds of birds; the Laguna is an important stop along the Pacific Flyway. According to the report compiled by the Laguna Technical Advisory Committee, the Laguna's wintering waterfowl once numbered in the hundreds of thousands (3). The report also states that the California yellow-billed cuckoo, a state listed endangered bird associated with mature riparian forest habitat, was last observed in the Laguna in the

1950's before channelization and deforestation. Especially apparent to us along our trip was that when there were trees along the banks, the width of this strip was usually no more than 10 feet.

A team of researchers under the direction of Miles Ferris and the Santa Rosa City Utilities District is working on overlay maps of the Laguna to determine how much of the area has been denuded of trees. The maps won't be completed until the end of 1989, but according to the Technical Advisory Report vast amounts of riparian forests and oak woodlands have been cleared for agriculture and for the excavation of flood control and drainage channels. The report goes on to conclude that even though a significant portion of the Laguna habitats have been lost or degraded, much remains. The remnant habitats must be protected against further loss. Much of the habitat that has been lost or altered can be restored, provided restoration is started before additional development becomes incompatible with Laguna protection.

Tree Planting in the Laguna

According to Rocky Thompson, horticulturist for Circuit Riders Productions, an environmental restoration service in Windsor, there are several groups that could be hired to revegetate the Laguna (4). Because of the proposed multi-agency management plan, crews could be hired from within the U.S. Fish and Wildlife Service, from within Cal. Dept. of Fish and Game, Californial Dept. of Forestry (CDF) could be hired; private

contractors or volunteer groups could plant. Any work performed would be done on a parcel to parcel basis as lands are acquired.

Major reforestation projects generally experience about a 60% survival rate. Circuit Riders, however, employs a unique planning system that sometimes results in 100% survival of transplants. Upon contract agreement, technicians from Circuit Riders go to or near a site needing restoration to gather seeds or acorns, and take cuttings from existing plants. Dominant tree species along the Laguna are oaks and Oregon Ash. Propagation takes place in their nursery in Windsor. A special soil mixture is used and young plants are moved to a 6" bottomless, tube-like container. The container prevents plants from becoming pot bound and rendering them unprepared for transplant into nature's hard soil.

Thompson believes this is the best system to ensure the greatest amount of survival. He contends that most nurseries buy their stock from wholesalers in Southern California, genotypes that are healthy but not acclimated to the different weather and soil conditions of the local region. Circuit Riders has already revegetated in the Laguna along one of the wastewater treatment marshes. The limiting factor to hiring Circuit Riders to replant the Laguna is that the capacity of their nursery and size of their crews allows for only about 15 acres of restoration per year.

Greenhouse Effect and the Laguna de Santa Rosa

In September, 1988, the American Forestry Association (AFA) unleashed a program called Global Re-Leaf. The goal of the

program is to create a national network of citizen activists dedicated to redressing the environmental imbalances at the root of the greenhouse effect (5). The focus of the program is to involve individuals and groups in tree planting projects across the country to absorb excess CO2 from the air. Last fall a group of 1,200 school children replanted a riparian zone along Herring Run, a main tributary to Chesapeake Bay. Funding comes from government grants and from corporate and private donation. On Sept. 19, 1988, Gary Moll, AFA's vice president, testified before the Senate Energy Committee on the National Energy Policy Act and urged Congressional support of tree planting projects to offset global warming.

Interestingly, a utilities company based in Arlington, Va., called Applied Energy Services, has contracted with an international relief and development agency to plant enough trees to remove 15 million metric tons of carbon from the atmosphere, the amount Applied Energy's new 180 megawatt coal-fired plant in Connecticut will emit as CO2 over the next 40 years (6). Daniel Dudek of the Environmental Defense Fund presented to Congress in 1988 that U.S. utilities companies could offset ten years worth of carbon emissions with projects begun now.

Also on the books is House of Representatives Bill 2838. This bill authorizes the Secretaries of Agriculture and Interior to provide donated or surplus seedlings, together with advice and technical assistance to any non-profit organization volunteering to plant tree seedling on public lands (7). Creation of the bill was motivated by Andy Lipkis of Tree People, a Los Angeles group

that planted 1 million trees prior to the 1984 Olympics. Mayor Tom Bradley has called on Tree People to plant another million trees in the next two years, specifically to absorb CO2 from that smog-laden area.

It is my contention, then, that many possibilities exist for restoring the wooded areas of the Laguna. Obviously, enormous tracts of forests are needed to offset the excess atmospheric CO2 (Fig. 5), but we're not exempt from taking regional measures. Mark Twain once noted, "everybody talks about the weather, but nobody does anything about it." Congressman William Carney (NY) addressed a Senate sub-committee on Environmental Protection on the Greenhouse Effect and commented nearly one hundred years later: "I have the feeling we had better do something and perhaps do it quickly." (8).

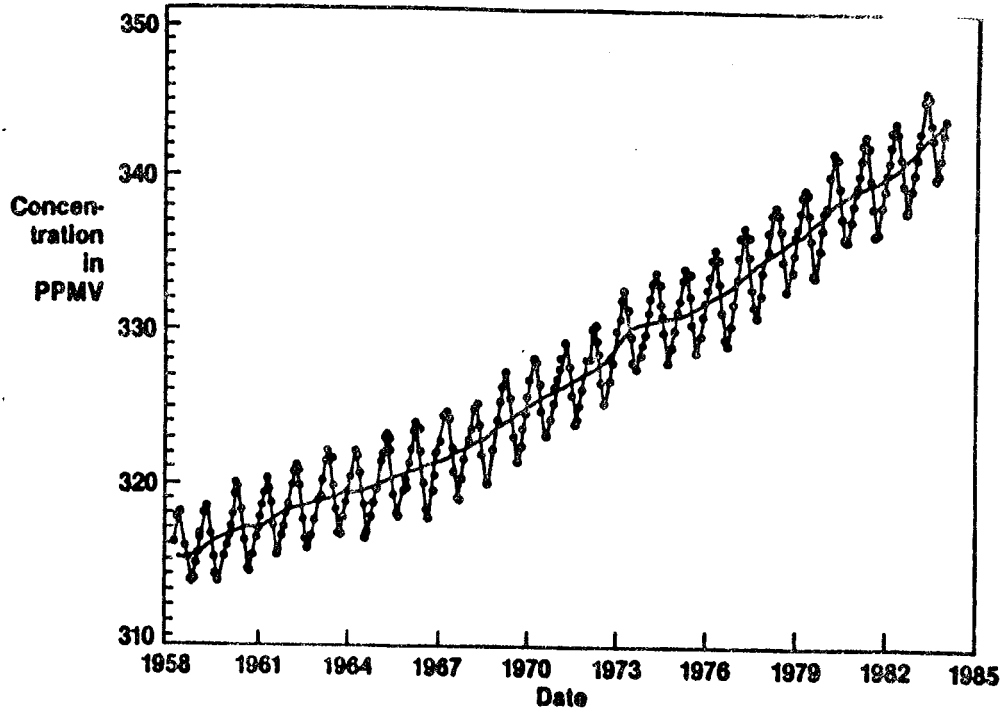


Figure 1. Atmospheric CO₂ Concentrations at Mauna Loa Observatory, Hawaii. Measured amounts show seasonal fluctuations, primarily of biological origin, superimposed on an exponential growth (Keeling, 1984).

From: Barbour, et al, Terrestrial Plant Ecology, Cummings Pub. Menlo Park, Ca. 1987

THE CARBON CYCLE

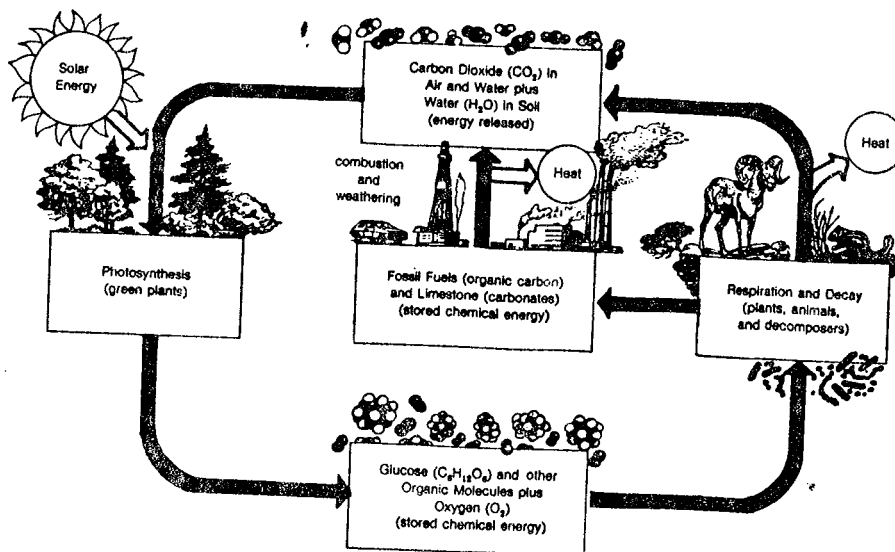


Figure 3. From American Forests, November/December, 1988

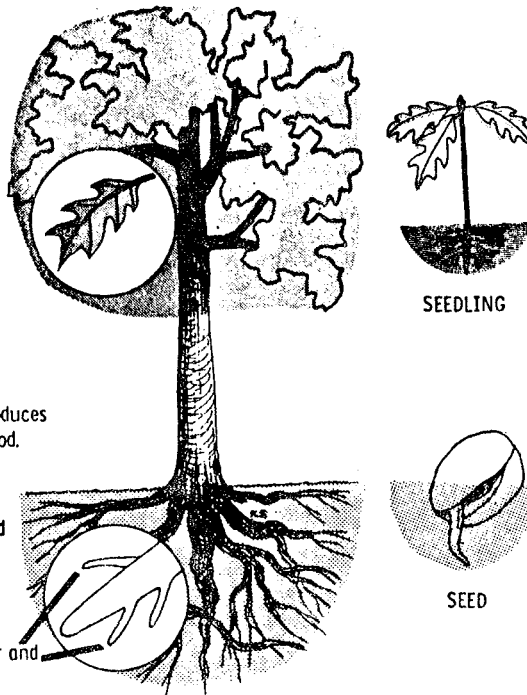
CROWN: where tree increases each year in height and spread of branches by adding on a new growth of twigs.

LEAVES: make food for the tree by combining carbon dioxide from the air and water from the soil, in the presence of sunlight, to form sugar. Moisture is given off through transpiration on the underside of the leaves.

TRUNK: supports the crown and produces the majority of the tree's useful wood.

ROOTS: anchor the tree, absorb and transport water and nutrients.

ROOT HAIRS: absorb water and nutrients from the soil.



HOW A TREE GROWS

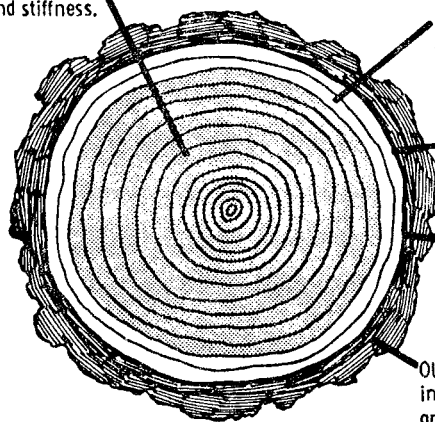
HEARTWOOD: inactive sapwood, which gives the trunk strength and stiffness.

SAPWOOD: (xylem) carries the sap (water plus nitrogen and mineral nutrients) from roots to leaves.

CAMBIUM: microscopic layer of cells where diameter growth occurs with the formation of an annual ring.

INNER BARK: (phloem) carries sugar made in the leaves down to the branches, trunk and roots, where it is converted to substances vital to growth.

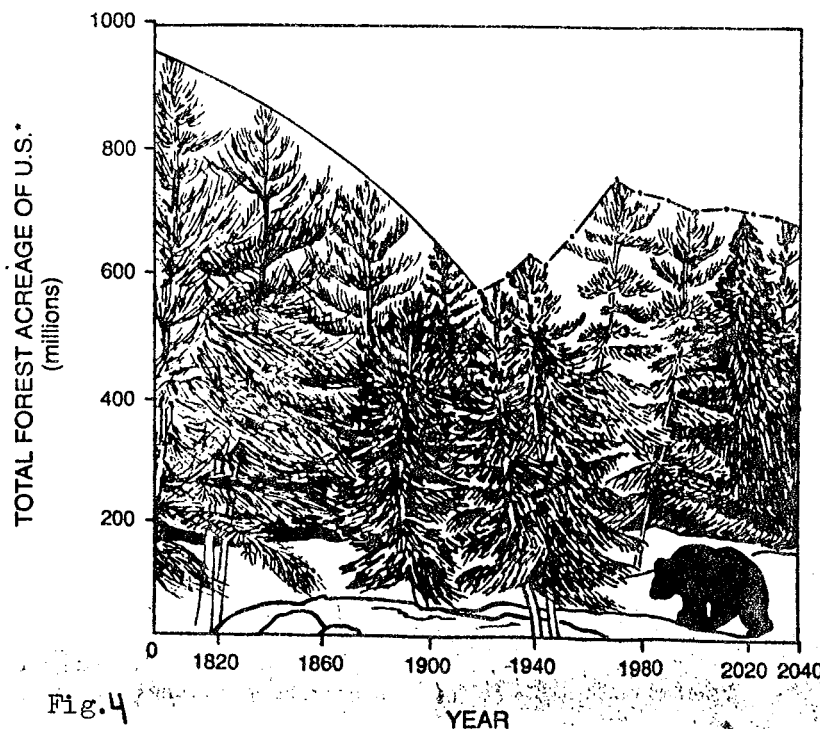
OUTER BARK: protects the tree from insects and disease, excessive heat and cold, and mechanical injuries.



TRUNK CROSS-SECTION

How a tree grows. (Modified from USDA Forest Service.)

Figure 2



*Dramatic increase due to acquisition of Alaska and Hawaii; projected figures are being reviewed now and will be released this summer.

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Figure 5

THE POTENTIAL OF FORESTS AS A CARBON SINK

SOLUTION	REQUIREMENT
Establishment of rapidly growing plantation forests	465 million hectares (ha) of new fast-growing forest (15 cubic meters [m ³] of stemwood per hectare per year)
Increasing the amount of forest biomass in existing forest area, either through increasing growth or decreasing harvest	Increased stemwood growth of 2.5m ³ /ha/year on all existing 3,000 million ha of closed forest
Natural increases in forest growth and biomass as the result of climate warming	Spontaneous net expansion of 3.5 billion ha in natural slow-growing forests (from 4 billion ha to a total worldwide closed forest area of 7.5 billion ha)

Note: This table assumes that the net annual increase of atmospheric carbon is 2.9 billion tons per year.

from: Environment, Jan/Feb, 1989

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STREAMBANK RESTORATION IN THE LAGUNA De SANTA ROSA

Term Project
For Professor Dr. Jean Merriman
May 23, 1989
Drew Ibach

The objective of this report is to emphasize the need for riparian forest restoration and protection in California and, more locally, to address the present condition and needs for the restoration of the Laguna de Santa Rosa. The quality of water entering the Russian River from the Laguna de Santa Rosa has dramatically decreased in the last half century. Increased local construction, marsh and streambed channelization, and riparian forest elimination, has contributed a great quantity of sediment to the water, thus creating highly eutrophic conditions. Farming techniques and past wastewater treatment accidents and overloads contribute nitrates, methane, phosphorous, coliform bacteria, and viruses, which lowers water quality by reducing the amount of dissolved oxygen while introducing health threatening viruses. Furthermore, insecticides, herbicides, and chemical fertilizers find their way into Laguna waters during periods of heavy rain and with irrigation runoff. Eroded land sediments, chemical fertilizers, oil from urban runoff and roadways, and direct human litter has spoiled the quality of both land and water along the Laguna and its tributaries. A riparian forest buffer along the banks of the Laguna and its tributaries will, if implemented, slow the natural process of erosion, act as a non-point source pollution filter and sink, cool the waters, provide habitat for native plant and animal species, help in the reforestation of America, and add aesthetic beauty to our county.

The quality of the water of the Laguna is a concern to many. The residents dependent upon potable Russian River waters are concerned with the condition of Laguna waters entering their drinking water. The local farming industry has a concern for the quality and quantity of water as many operations draw irrigation waters from the Laguna. California Fish and Game, naturalists, fishermen, duck hunters, bird watchers, concerned citizens, and environmentalists all have their concerns for the quality of water of Californias' deminishing wetlands. And last but not least, the silent majority of both hearty and sensitive native plant and animal species now facing the very real possibility of ex~~st~~inction due to the loss of native habitat are dependent upon the preservation and restoration of Californias' natural waterways and accompanying riparian forests for their survival. The Laguna de Santa Rosa is the floodplain and drainage basin for two hundred and fifty square miles of golden Californian mountains and meadows, and is home to the second largest natural wetland in northern California. It is past due time that we inher~~it~~ the responsibility for protecting the integrity of our homeland by adopting strong measures to protect and restore both forest and water resources by starting in our own back yards here in Sonoma County.

The adoption of a strong riparian buffer strip along the banks of the Laguna and its tributaries is paramount to the success of reestablishing the quality of both water and native plant and animal habitat in Sonoma County and through^{out} California. Congressman Doug Bosco's proposal to aquire federal funds designated to protect national wetlands by establishing a national wildlife refuge in the Laguna area, is by no means a guarantee that water quality and native plant and animal species preservation will be insured.

Since land acquisition will be on a willing seller basis only, lands not acquired by the Federal Government or California Fish and Game will undoubtedly continue to contribute to the degradation of both land and water resources in the area unless a firmly enforced riparian buffer zone ordinance is adopted by the county. To fairly compensate the farming industry and landowners bordered along the creeks, and streams, and main channel of the Laguna, landowners should be subsidized for lost crop revenue, or better still, the land should be purchased by the Federal Government, the State Government, or by the County of Sonoma at fair market values to provide a natural riparian buffer to filter and protect our scarce water resources.

"Riparian habitat provides living conditions for a greater variety of wildlife than any other habitat type found in California."1 "The high biological productivity of California riparian habitat can be seen in the following examples. The coast redwoods develop best on riparian floodplain sites producing the largest biomass figure known: 452,500 grams per square meter (Franklin & Dyrness, 1973). The grandest hardwood forests in California undoubtedly once bordered the Sacramento River."2 "Descriptions of lush jungles of oak, poplar, sycamore, ash, willow, alder, and wild grape which comprised almost impenetrable walls of vegetation along the major valley rivers and their tributaries were recorded in the early 1800's. Reports of huge oaks 27 feet in circumference and sycamores reaching 75 to 100 feet tall have been recorded."3

*1,2,&3 " Annotated List of California Habitat Types "
#1 P. 1 #2 P. 2 #3 P. 1

"Further, some of California's most rare and endangered plant and animal species are limited to the riparian habitat. An example is the beautiful wild hisbiscus, Hisbiscus californicus, an herbaceous perennial shrub with 15 - 20 cm diameter white and dark red flowers found only on the few undisturbed slough banks which remain in the Central Valley." 4 "Also, the bald eagle and the American peregrine falcon which are included on both Federal and State lists of endangered species, occur in our Laguna de Santa Rosa. Surveys indicate that 286 species of plants, 230 birds, 25 mammals, 19 fishes, 7 amphibians, and 9 species of reptile have been discovered living in our Luguna." 5 "Only a small fraction of the original riparian forests which covered several million acres in California remains today. It has been estimated that merely five percent ^{remains} of what once was an indomitable stand of riparian forest land in California, ^{has} been cut away and grazed over in the last one hundred and fifty years. For example, the Sacramento river had 800,000 acres of riparian vegetation left in 1848 and 12,000 in 1972. Major man-caused changes have been conversion of forest to orchard and field crops, logging for wood chips, streambank stabilization, and accelerated erosion of river banks due to dams upstream and channelization in adjacent areas. Further losses of habitat are attributable to gravel and gold mining, grazing, and water pollution. Urbanization brings housing developments, freeways and landfills to the riverlands." 6 The diminished condition of riparian habitat in California must be restored and preserved before the threshold of tolerance becomes too thin for several native plant and animal species as they have already begun to disappear from the landscape.

*4&6 "Annotated List of California Habitat types"

*5 "Fish and Wildlife Restoration of the Luguna de Santa Rosa"

#4 p.3 #6 p.4 #5 p.3

We are fortunate in Sonoma County to have the opportunity to create a National Wildlife Refuge and reclaim a small piece of our landscape heritage before the condition of the Laguna area becomes beyond riparian repair. Luckily, there is enough native remnant habitat remaining to expand upon to create a very unique wildlife refuge. "The Laguna de Santa Rosa supports a very diverse and complex system of wetland and upland habitats, including: open water, emergent marsh, riparian forest, vernal pools, oak savanna, oak woodland, and grassland."⁷ These very unique land characteristics create the support for a broad spectrum of plant and animal species indigenous to our area and also supports visiting water fowl who need to refuel along the Pacific flyway. If we do not have the foresight or courage to protect that which is truly valuable at this time, our opportunity will have been missed. I've been told that Sonoma County has the land and water resources to potentially become the next San Jose or just another sister city to San Francisco. If we do not act now to firmly lock the land into agricultural preserves with accompanying riparian buffer strips, or create this wildlife preserve in the Laguna area, the farmers will soon be squeezed right off their lands and development will engulf another portion of our diminishing wetlands and open spaces. Local dairyman Arthur Lafranchi predicted at a public meeting on the Future of the Laguna de Santa Rosa, that within 18 months present economic pressures would likely collapse the dairy farming industry in Sonoma County.

*7 "Fish and Wildlife Restoration of the Laguna de Santa Rosa"
P. 2

So unless Federal or State agencies are willing to purchase our natural wetlands, sale, subdivision, and urbanization will occur in private hands at the current wildfire pace of county land development. The development of a National Wildlife Preserve does not mean that agriculture will be squeezed off the land just as urban development would have done. National Wildlife Preserves provide grazeland for neighboring farmers in many cases and it would be both logical and probable that this would be the case in our Laguna area. The term "friendly neighbor," has been echoed time and again by fishery biologist Bill Cox of California Fish and Game, and by Chairman Bob Sharp of the Laguna Technical Advisory Committee to Congressman Doug Bosco, as well as other members of the committee.

To restore streambank stability along the bare over-grazed portions of the Laguna, I suggest helping the natural process of plant succession by planting the heartiest pioneer species of native riparian trees and shrubs along the banks. Let nature run its course where it was meant to roam by securing the banks in roots and shade to cool the water and slow the erosion process. Trees will pull the carbon from the air, aid in America's reforestation process, provide a selective cutting resource while creating aesthetic beauty, and provide a home for the many homeless creatures we've nearly plowed under and built over. My first plans for aiding the restoration process of the Laguna were perhaps noble, yet unrealistic. I found that determining the area needing replanting from aerial photographs and county land use maps is virtually impossible. With an up front view of Laguna conditions discovered by canoe travel, one can easily see that within 100 feet of the streambank area, conditions can change dramatically.

Plant restoration will need to be determined By Soil Conservation Service Technicians and experienced native plant landscapers on a site by site evaluation basis.

Where conditions are the worst, bare and grazed to the edge, " Mule fat (Baccharis viminea), sandbar willow (Salix hindsiana), red willow (Salix laevigata), and Fremont cottonwood (Populus fremontii) are the dominant species in the pioneer stages on riffle bars, point bars, and at the base of the floodplain terrace." 8 Willow cuttings are often used under gravel and rock riprapping for stream-bank stabilization where hearty willow sprigs develop quite rapidly and soon cover the stone and hold the bank in place. A cheaper solution than using riprapping methods would likely be to plant established plants of six to twenty-four month old seedlings in the fall so that winter rains can provide the start they need. A five year planting scheme would be wise in order to replace failed starts, and further, to add a greater variety of second stage successional plants. Such plants would include Red alder, Oregon ash, Valley oaks, Hinds walnut, Arroyo willow, and Box elder. Buckeye, Coast live oak, Elderberry, and California bay also can do well further up from the banks and they enjoy the company of other established trees. "Results of a survey along Dry Creek in Sonoma County of the mixed riparian woodland show a dominance of alder, cottonwood, and red willow in the bank environment." 9 These species do best both initially and in the long run because they are more tolerant of root exposure and when partially buried by the silt deposits as they are capable of developing new root systems and continuing their growth.

*8 "Riparian Forests in California" p.110

*9 " " p.116

" Left undisturbed by man, the cottonwood/willow floodplain woodland will undergo succession to a mixture of Hinds walnut, box elder, oak, bay, with significant variations in basal area and relative density in relation to swales and floodplain terrace locations. As the floodplain terrace builds in height or extends into the stream channel, one can anticipate an increase in the importance of the more drought tolerant species such as oaks and bay."10

Native and drought tolerant shrubs and herbaceous plants should be planted along the banks where trees are impractical due to channel dredging needs in urban areas. Drip or other forms of irrigation may be necessary to develop and sustain these plants as they will be under greater heat stress without shade trees overhead. I noted blackberry bushes along the banks of the Laguna in full sun with no irrigation help, however blackberries act as such an effective barrier that it may or may not be a desirable plant in urban areas. In rural areas where trees are being restored to the landscape, shrubs and herbaceous plants should not be introduced so as not to compete with the tree starts. A natural understory of grasses, wild rose, wild grape, and many others will develop under the trees on their own.

I've covered a lot of ground in this report however, all is interconnected and important to a restoration effort. When you look into a project of this magnitude you find many issues to deal with and balance such as politics, water quality, habitat preservation, wetlands protection, farming, urban growth, wastewater treatment, and pollution. I can only add that I hope the public awareness of the Laguna and its' surrounding issues increases and that people in the county respond in a positive manner.

*10 "Riparian Forests in California" p.118

It is time to act now while peoples environmental awareness is heightened by recent events and before the Laguna degrades fully into a sewage channel outfall into the Russian River and further into the coastal waters off California. The one thing that I haven't mentioned is the educational tool the Laguna is and can still be if better protected as the natural occurring wetland that it is. This project has been challenging and has opened my eyes to the current state of natural living elements struggling for survival in our national wetlands and in our Laguna de Santa Rosa.

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Technical Advisory Committee. Many Thanks!

A SADDENED LAGUNA FOUND AWAITING REVIVAL
(A canoe adventure sights present conditions)

By : Drew Ibach

Thick brown crawling liquid greets my paddle as we begin our journey down the seldom seen nor intimately known Laguna de Santa Rosa. Our canoe enters hesitantly just east of Sebastopol where the Laguna slips mysteriously under Highway 12. The surrounding riparian forest is thick yet narrow, protective and cool, as it divides the sleepy waters from the rustlings of mankind. The sight of the forest, the warmth of the sun, the sensation of smooth quiet movement, begins to thaw the urban chilling of my five most precious senses to a state of peace and tranquility. Then suddenly my nose is wrinkled, offended, and fully assaulted. My whole face cringes with the taste of oil now glued upon my tongue as swirls of purple, blue, and silver rings of oil spin in a kaleidoscope of patterns upon the murky surface of the once innocent waters. The contrast is unsettling and distasteful, perhaps warning me of the realities that lie hidden ahead. We paddle onward in hopes of finding friendlier waters.

Further on we are greeted by foraging dairy cattle who find the lushness and shade of the willow, oak, walnut canopy to their pleasure. Lower walnut limbs and duckweed are the favored delicacies today. Neighboring plant species include blackberries, yellow blooming iris, cattails, poison oak, wild rose, and many varieties of tall green grasses lushly grown with the sweet rains of March. Grazing access to the channels edge provides a handsome

variety of munchies which the cows frolic and delight in. Other notable characters have responded to our intrusion, frogs jump, tadpoles scurry, even the tailfin of a large catfish emerges from the goo to turn against the bank disturbed by our paddles. Birds are chirping and singing down to us from their throned upon the treetops, and all feels well and right again.

All too soon our journey is stalled. The channel fractures into smaller tributaries, a mass of boards, and sticks, and garbage blocks our way. Aerosol cans, tennis balls, slime, retired tires, and oil, stands still and merged together all afloat upon God knows what, yet has not created. We land the canoe and travel on foot searching for water more suited for travel, but to no avail. The Laguna slips through the jungled thicket bordered on either side by farm fields and sunshines. Fifty-five gallon drums of oil half full and rusting away are tangled between the willows. Ironically, we discover a dead raccoon lying still not more than fifteen feet away, cause of death unknown. The graphic impression clearly brings home the point that oil spilled upon the waters or cooked into the air, kills. We walk along the fence-line at a point far from the main channel. Out of character from the norm, a large section of marsh is fenced off from grazing access. We spot a jackrabbit scurrying along the cow trail ahead of us. A large cement conduit is draining the reed filled area where minnows are sighted in much cleaner appearing water.

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In chaotic escape maneuvers, one minnow springs from the water and happens to land on an island of swampgrass where my hand reaches down for its capture. It is a baby carp who squirms between my fingers, anxious to return to the shallows of the stream below, where freedom depends on the quality of water that makes his home. All the creatures of the laguna depend upon the faith of mankind to keep the waters pristine and flowing, to keep the marsh a marsh and not fill it nor channelize it in order to further man's development upon the existing home of the voiceless many. Having only travelled a half mile upon the laguna and another quarter of land we find we have to turn back and try another location further north. Loading the canoe onto the truck has lost its charm from the first. We travel in hopes of finding better access.

We travel to the next major overpass on Occidental Road. Two engineers are there studying the decayed construction of the bridge. Brian and I have our own opinion of the structure. We think it looks like some five-year-old boy got happy with his lincoln-log-set one day while ^{his} father copied the design and sold it to the city. Anyway, we feel a whole lot safer and happier in the canoe than on the road. We pass through a heavily grazed region where the channel is straight and the banks are low. Lonely old valley oaks are all that accompany the grasses and cows who curiously follow these strange men and their vessel. Seldom if ever have they seen man, woman, or child upon the waters of their homeland. I wouldn't trust us either if we were them, and so they follow us to protect their domain. Another barrier surfaces as strands of barbed-wire stretch across the channel. With greatly less than fancy maneuvers, we somehow squeeze the canoe and ourselves through.

Several natural snags of fallen trees, and tangled sticks and logs, make our way nearly impossible as time and again we are forced to pull the canoe around various barriers. Bridges and fencing were major contributors of such barriers. Perhaps the greatest challenge to the journey was getting through such awkward places not designed for canoe travel. Limbs were always hanging us up and scraping us as we went by with each limb claiming some sort of toll paid in flesh, or some rock claiming paint from the bow or stern of our canoe.

Thankfully our greatest challenge was not our greatest pleasure. The egrets and blue herons were as spectacular as they were graceful and by land's end we were to sight in excess of one hundred herons and perhaps fifty egrets. Our brightest surprise came in the most unlikely of places. Along to the east was a huge farm flooded lake maybe ten acres in size and two feet in depth where mallards could be seen in all their glory. To the west a thin layer of willows swayed in the breeze ^{from} the banks and a few more reached up from the depths of the channel. A small man-made island separates the flooded farmland from the channel of the luguna. Brian sights something swimming across the channel. Is it a beaver, a ground-hog, or an otter by chance? The smooth rusty brown mammal reaches a willow thicket and begins to climb up into the lower branches. We are excited and delighted in determining that our friend is an otter approximately thirty inches long, rare, and beautiful. Travel is becoming smoother and more rewarding as we paddle northward, pleased with our decision to make this journey.

4-2

A flock of geese are sighted on a pond to the west where a finely groomed vineyard is bursting with spring growth. A duck-blind is hiding among the reeds and cattails to the east of the vineyard. Only a few scattered cartridges and an abandoned thermos are all that remains of the early morning sit-ins where waiting becomes the dominant activity of the hunters. Close by a stagnant pond filled with many cottonwoods is as green and thick as pea soup. Algae makes a sponge like mat of the water. Obviously, snorkeling is the survival sport of the gilled inhabitants trapped inside this sea of green. Probable cause of this algae bloom explosion is determined by supposition to be chemical fertilizer runoff from the nearby vineyard, however, many farming practices contribute oxygen demanding wastes to laguna waters, tilling up to the channels edge, grazing up to the banks of the laguna, and excavation and filling of the lowlands for greater productivity and quantity of croplands are sighted. Seemingly, every vineyard along the laguna has one or more pumping generators that draws directly from the channel. We spotted at least a dozen pumping stations parked at the crest of the bank where large six inch pipelines steal the water from the friendly finned, feathered, and furry inhabitation of the laguna. The local community treats the laguna both as a resource and as a sewer. Thirsting grapes and field crops stir their straws and drink from the laguna, while others cast, and spill, and send their garbage and toxic wastes covertly through the brush and down into the hidden and almost forgotten laguna.

A startling discovery grabbed us both, at first, by our noses. A white encrusted streambed sending clear liquid racing downward from ten feet above the channel was contributing an awful gagging sulfur smell to the air.

We could hardly imagine the effect it was having on the helpless fish in the water. We investigated the source and found the culprit being a garden hose leading from a leaky connection which was spewing out sulfur water from an eight inch steel pipe coming straight up from the ground. The adjacent ^{field} ~~feld~~ was ungrazed and uncultivated. It became obvious that this point source of pollution was being piped across this field from another, where we could see a newly planted and cultivated vineyard. The sight of direct pollution aggravates all your senses at once. My thoughts were vile and angry, my nose was inflamed and burning, my tongue was bitter and spoiled, my eyes began to tear. The forces of both good and evil continually clash along the banks of the laguna.

Were it not for that one point source of pollution the conditions of the laguna were improving considerably just south of Guerneville Road. The banks of the laguna were much higher overall which allowed for more vegetative cover to protect and cool the faster moving waters. Also a more pronounced diversity in plantlife was popping up all around the stream.. Bay, Eucalyptus, Redwoods, and Toyon trees kept company with the Willows and Cottonwoods creating a fuller sense of harmony within the wilds. Further, even the herrons seemed larger and healthier as they would guild down the dampened airways between the banks nearly filling the gorge with their tremendous wingspans.

Just when all felt smooth and easy, tragedy ironically struck again. A barbed wire fence stretching waist and neck high across the laguna in swiftly ^{moving} ~~moving~~ waters, hung us both out to dry.

We tried to land the canoe just before the fence-line as one end of the canoe touched the bank and the other came parallel with the fence in the middle of the stream. I was holding off the barbs when the current suddenly swept the canoe right out from under us. Instant soggy disaster! All possessions began to immediately escape in floating plastic bags as I hurried in three to four feet of water to capture them. To my thankful surprise, the channel bottom was firm and clay-like and not at all soft and muddy like many previous areas we might have capsized in. Wringing out our clothes and sun bathing dry fills thirty minutes with laughter and jokes about our skills as navigators while we avoid the thoughts about the deadly nature of barbed wire which maims so many mammals. When the laguna someday becomes a wild-life refuge the barbed wire along with the many items of garbage spoils as well as abandoned automobiles, have all got to go. A steady flurry of snow-like seeds keeps floating on by all white and airy from the multitudes of blooming weeds, grasses, and willows. Spring is truly in the air along with her pest of a cousin mosquito. All is peaceful once again as we slip effortlessly downstream in the carrying current. We've passed a couple of shell baked turtles and some old corn fields, as we begin to enter the thicket again where the mosquitos are on the hunt. Just when dusk brings a lull and a hush to the trees, the creatures, and even some country folk, it also brings with it the blood thirsting insects. Make no mistake about it, the laguna breeds more insects in a summers week, then mankind procreates in a century.

Purhaps this is why so many birds come to live and visit here during the year. There is plenty of cover, and seeds, and flies, and open spaces to live in and on in our laguna, as long as it remains a wet-land and not just a channel of mud. Gallon for gallon, the Russian River in all its splendor and glory, cannot match the bird concentration found along the beaten banks of the laguna.

We retire our journey at dark merely three quarters of a mile from the Russian River. We had come so far and seen so much, yet still were not satisfied with finishing short of the river. The following morning we had agreed to retrieve the canoe stashed under the bridge at Wohler Road. Alluring waters awaited our return and drew us in and away from all responsibilities upon our return. And that is the magic of water, and forest, and open green spaces, to draw you away while consuming all your senses, taking pride in reminding you of your ancestral roots. It is good to return home again. Water has such alluring powers that with just one touch you're hooked, drawn in, and soon fully submerged in all her secrets and mysteries. You can't help but have compassion for that which holds you so dearly. While a baptismal in laguna waters is not now recommended, it does still hold a skill for cleansing the soul and refreshing one's heart.

With little trouble we reach the Russian River. Fantastically large Blue Herons greeted us along the way, tending not to mind so much our encroachment upon their waters. The contrast in water quality is like comparing night to day. The laguna water is deep dark chalky brown. The illusion of a quicker paced current along the laguna had fooled me into believing that the water quality had improved and was actually alright. But when laguna waters meet Russian River water,

you can hardly believe the word water is applicable to laguna goo. The amount of suspended soils in luguna waters is staggering. How can anything live in that environment? A heaven for insects and birds perhaps, but a tragedy^{For} trout and steelhead. In contrast, the Russian River near Mirabel Park has a much wider and more greatly matured riparian forest along its banks. The current moves swiftly and you can see the sandy gravel bottom three to four feet down. The water is so clean and refreshing, the sun is so warm and relaxing, that we are drawn from the confines of the canoe into the refreshing true waters of the river. Swimming in our birthday suits in crisp clear water completes our spiritual rejuvenation and draws to a conclusion our great adventure within the Laguna de Santa Rosa.

Our spirits have been recharged by forest, and animal, and water, but time can no longer stand still for us. We return back to urban reality driving the canoe further and further from the rivers calling. The sight, sound, and smell of traffic begins to chill my senses once more, but fond memories will travel with me and hopefully prevail until I can escape again to some protected zone of wilderness. I will wear a full smile as long as the memory of guilding herons and swimming otters remains fixed and clear in my memory. Laguna de Santa Rosa sleep well tonight for you are not forgotten, and you may soon reawaken to past glory and beauty.

The Possible Restoration of Salmon and Steelhead in The Laguna De Santa Rosa

Wendy Northcutt

May 9, 1989

Dr. Jean Merriman

Department of Environmental Studies and Planning

"Life is the flow of energy through time and space. The watershed is the natural geographic unit of measurement, and the salmon is the primary indicator organism of the quality of life within the watershed."

C. J. Kreger

Author's preface

The Salmon and Steelhead in the fisheries of the Russian river basin have been seriously depleted in the last few decades. For this reason, President Reagan signed a law which would provide funding for the research and development of the Russian River fisheries. This law provides for the study of the habits and populations of the Salmon and Steelhead trout which migrate up through the River to their spawning grounds. Restoration efforts are also under way for the Laguna De Santa Rosa, a wetlands area which drains into the river. Historically, Salmon and Steelhead used to spawn in the waters of the Laguna, but they have not been seen there in recent years. However, some feel that if properly restored the Laguna could once again provide the necessary habitat to sustain the Salmon and Steelhead fish. The Salmon and Steelhead fishing industry has been given priority at the state's capital when it comes to water rights. The agriculturalists have been given water rights over them. This comes down to the water going for irrigation rather than in the streams for the fish. It is not out of the possibility of restoration for Salmon and Steelhead in the Laguna De Santa Rosa, because if we restored it we could help to enhance a failing industry. However, after conducting my research I have come to believe that it would be better for the Laguna not to restore the Salmon and Steelhead populations at this time. Because the habitat is too diverse, and more legislation will need to be passed not only for the fish but also for the birds and mammals. And what would cause the loss of the Salmon and Steelhead? But in which direction must we go? And what would cause the loss?

immediately while obtaining them.

Salmon and Steelhead

The Russian river is one of the most important Steelhead rivers in California. New Zealand stocked its own inland streams with fish from our river because the fish were so spectacular. The populations have been diminished over the decades because of the increase in urbanization. The incredible growth around the river has caused among other things an increase in logging, which has caused the banks around the Laguna to start to erode away. Another problem is the land around the river has been under the ownership of people with out much interest in preservation. As a result many spawning areas have been ruined.

In recent years the Federal government has been taking an interest in restoration of the fisheries throughout California. Public law 100-653 signed by President Reagan, is specifically aimed at restoring the Russian River fisheries. The law, still in the early stages calls for detailed studies to be completed by October 1991. Besides describing the habitat and populations, the waterflow will be studied, not only for the river, but its tributaries, including the Laguna De Santa Rosa.

The legislation throughout the state regarding streamflow for fisheries has affected the Russian river, there has been controversy over the discharge of treated waste water into it. The Llano treatment plant which discharges into the river, is allowed to discharge 1% of the river's flow. Many residents around the river are worried about this, because they pull their drinking water from downstream of the Laguna, where it is discharged into. Consequently, the Laguna can become very shallow, and dry. For use as a flood plain this is desirable, however to sustain Salmon and Steelhead there just isn't enough water.

In hopes of restoring the Laguna as a nursery for Salmon and Steelhead, the Laguna Technical Advisory Committee will begin an indepth look at the Laguna sometime in October 1989. Until then, however, not much data can be found relating Salmon and Steelhead and their habitats in the Laguna, because as of now there are not any anadromous fish (fish which swim upstream to spawn) living there. Salmon and Steelhead need clean, fast moving water with clean, rapidly moving water. This is not the type of habitat it is today.

The Laguna De Santa Rosa is a warm water wetland, mainly because of the deforestation of the riparian forest which once surrounded the Laguna. The removal of riparian vegetation has warmed up the water because without roots to hold the soil in place, the banks along the Laguna have begun to erode away which has causing it to fill up. Consequently, the wetland is much smaller than it used to be. This has also been helped by the some agriculturalists who have drained parts of the Laguna to acquire more land for grazing cattle. Channelization of the Laguna has also added to the warm water by keeping it shallow. In times of flood the Laguna is very important as flood plain. Channels were built to keep the water moving through the plain rapidly, in case of flood. In periods of low rain when the Laguna needs all the water it can get, the channels move the water through, leaving many places all dried up.

Salmon and Steelhead need good quality of water. The effluent from the LLano treatment plant has improved over the years due to efforts from the treatment plant to clean it up. However, it is still far from the pristine conditions of decades ago. The high concentration of nitrates, phosphates, and chlorine have helped to deplete the water of oxygen the fish need to thrive. According to the Laguna Technical Advisory Committee, there can be more reclaimed water going into the Laguna with out any environmental problems, which would help if Salmon and Steelhead were to spawn there. Adding to the water quantity problem is the consideration of diverting the water to the Estero Americano. If that were to happen, the Laguna could dry up completely. If the Salmon and Steelhead were to spawn there they would eventually have to adapt to short run seasons to avoid getting caught without water, this could be difficult for people to try to control.

As a warm flowing body of water, the Laguna is completely opposite from what Salmon and Steelhead need. Restoration of their habitat would require a great deal of man made modification. The installation of fish screens downstream and spawning gravel in the appropriate places. In restoring the Steelhead to streams in Peruena, Tom Farmer and his high school biology class had to carefully monitor the areas to keep them free of debris, after and after rains which could disrupt their spawning. It was a daily process, and so delicate that they kept the location of their restoration project a well kept secret, but just moving upriver of their habitats is required but the fish themselves, have to be handled with great care. Salmon and Steelhead fish come back to where they spawn because of information when they are young. They know where home is released by the spawning, thus guides them back to where they first

smegmated. In order for their restoration in the Laguna, smelts would need to be released there. This would require the eggs and sperm of adults to be artificially propagated in a hatchery first. This could mean building a hatchery at the site. Such an undertaking would cost millions of dollars, and would disrupt the existing habitats around the Laguna.

As a national refuge the Laguna's restoration efforts will focus on two problems, the restoration of riparian habitat and the water quality. Any such restoration would benefit the Salmon and Steelhead. If the riparian forest was replanted the water would become cooler and there wouldn't be as much sedimentation occurring. The water quality will also certainly be improved by restoration efforts, as the Llano plant is always increasing its efforts to discharge better quality of water. This will greatly benefit the warm water fish such as the carp and bass which now inhabit the waters. As a refuge, the Laguna will have more status with legislation, and more say in the water decisions. However, even with these efforts I feel that the habitats between what Salmon and Steelhead need and what exists in the Laguna now are too diverse for any restoration effort to be successful in the next few years. Perhaps in twenty years after the Laguna has been restored quite a bit, it might be a consideration, but I think that any fishery restoration efforts should now be concentrated in habitats upstream. An example is the building of a fish hatchery at the base of the Coyote Valley Dam near Ukiah. When a dam is built it disrupts the natural flow of spawning. For anadromous fish, in many cases, a mitigation hatchery is built to make up for the loss of fish habitat, provided the funds are available. As of now the Army Corps of Engineers has shown a willingness to build and operate mitigation facilities to compensate for the loss of Salmon and Steelhead as a result of the dam, but will not request the funds required from the federal government.

As with any wetland restoration plan there is the decision whether to restore what is there now with what was there historically. In some cases it can be a great asset to have restored the place to what it once was. I think that in the case of the Laguna, the committee working on this will need to first bring the wetlands up to a considerable quality before any Salmon and Steelhead restoration can be done. With the growth of the area, the increased effluent, and erosion around the Laguna I do not think that it can ever become what it once was, and trying to recreate that pristine habitat for the restoration of Salmon and Steelhead could be an intense way to spend the government's money.

SUMMARY

With Federal involvement in the fishery restoration program going on in the Russian river it is hopeful to think that some of that money and expertise can go to restoring the Laguna to become a nursery for Salmon and Steelhead, however, I think that there are too many factors against this at this time. The state of the wetland due to deforestation of riparian habitat, the water temperature, quality and quantity is not suitable for Salmon and Steelhead, and it could be some time before it is. I think that the fishery restoration efforts in the Laguna should be concentrated on the types of fish which now inhabit the waters, by enhancing their present habitat. After the Laguna has been worked on and enhanced for many years it might possibly be considered for Salmon and Steelhead. As of now I think the Russian river fishery restoration efforts should be placed on building a mitigation hatchery at the Coyote Valley Dam, improvements on the Warm Springs Hatchery, and on improved legislation regarding the fisheries in the state and nation's capital.

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LAND USE MANAGEMENT
in the
LAGUNA de SANTA ROSA

STEVEN LINDBECK

ENSP 321

SPRING 1989

LAND USE MANAGEMENT IN THE LAGUNA DE SANTA ROSA

by Steven Lindbeck

In 1985, my wife and I bought our first house. It was in Cotati, in what they referred to as "the one-hundred year flood plain," and the lender required us to purchase a flood insurance policy. That was my first experience with the National Flood Insurance Program, (NFIP), and the Federal Emergency Management Agency, (FEMA).

At the beginning of this term, I learned that the flood plain we live in is the Laguna de Santa Rosa. However, I was soon confused by the different terms of reference applied to the Laguna: flood plain, floodway, floodway fringe, and wetland. I came to realize that many residents nearby may have similar uncertainty in recognizing the functions, definitions, and characteristics of the various aspects of the Laguna.

Looking at different maps gives a number of different pictures of the Laguna. On some maps, the Laguna is a slender creek, winding through agricultural districts (figure 1). On the flood insurance maps, the Laguna is a channel, called the stream channel, flanked on both sides by an area called the floodway, which is itself flanked by the floodway fringe, the whole being called the 100-year flood plain (fig. 2). The Laguna de Santa Rosa Technical Advisory Committee mapped an area called the Greater Laguna de Santa Rosa (fig. 3), comprised of most of the unincorporated area between the borders of Sebastopol, Rohnert Park, and Santa Rosa, and reaching near to the Russian River. Not finding a definitive answer to the question "What is the Laguna?", I went looking at the definitions themselves.

WETLAND

The Laguna is an example of an inland wetland, according to Miller, because it floods when the Russian River overflows its banks (106).

100-YEAR FLOOD PLAIN

The area which would be affected by the level of flooding, with a one percent chance of flooding in any year, is called the 100-year flood plain (42 USC 4121).

FLOODWAY

The floodway is the channel of a stream, plus any adjacent flood plain areas that must be kept free from encroachment, in order that the 100-year flood be carried without substantial increases in flood heights. As minimum standards, FIA limits such increases to one foot, provided that hazardous velocities are not produced (FLOOD 3).

FLOODWAY FRINGE

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. It encompasses the portion of the flood plain that could be completely obstructed without increasing the water surface elevation of the 100-year flood more than one foot at any point (FLOOD 3).

The land use constraints already in place are based on these key descriptions, but to understand those constraints, a brief historical background is necessary.

From the beginning of time, flood control was pretty simple: people got out of the way or they perished. Smart planning meant pitching your tent on high ground. Even in recent times, cities

were built on lands relatively free from flood hazards. For example, we wouldn't have seen Santa Rosa settled two miles further west than it did.

By the twentieth century in America, the Corps of Engineers and the Bureau of Reclamation had mastered the sciences of dam building and channelization, and it seemed every water district in the country emulated the masters. Man could now control where water would go, and in what quantities it would flow. Or could he?

One result of this protective construction, was continued and even more intensive development of flood hazard areas. The land in the Laguna could dry earlier in the spring, and became even more agriculturally productive. More people made their homes year-round, on the banks of the Russian River.

But beginning in the 1940's, experts suggested that all water control problems might not be answered with structural solutions. For example, in 1953, the Tennessee Valley Authority provided local communities with flood hazard information, to assist the local planning agencies in making land-use decisions. In the Flood Control Act of 1960, in order to facilitate local and state participation in flood plain management, Congress authorized the Corps of Engineers to prepare flood plain information studies requested by local and state governments.

The California legislature went far beyond earlier federal efforts. The Cobey-Alquist Flood Plain Management Act of 1965 did more than just provide information, it placed strict limits on development. The law prohibits construction of structures in the floodway which may endanger life, or significantly reduce the

carrying capacity of the floodway. Furthermore, the law permits developments within the floodway fringe area, only by giving full consideration to the protection of human life, and the carrying capacity of the flood plain (WC 8410).

In 1968, Congress passed the National Flood Insurance Act, which established the first federal goals of non-structural flood plain management, and which produced a financial carrot to compel local and state governments to comply. Some of the purposes of the act include: to encourage state and local governments to make appropriate land use adjustments, to constrict the development of land which is exposed to flood damage, to minimize damage caused by flood losses, and to guide the development of proposed future construction, where practicable, away from locations which are threatened by flood hazards (42 USC 4001). The carrot was defined in section 4002 of the act, which required, as a condition of future federal financial assistance, that state and local governments adopt adequate flood plain ordinances, consistent with federal standards.

Local flood plain management ordinances are contained in the Sonoma County Flood Control Act. Some of the stated purposes of the act are to offer the minimum obstruction to the free flow of water, to control flood and storm waters, for land and other property within the district to be drained and protected from the effects of water, and to protect life and property from floods (UC 7757). Policy SE-2g of the next Sonoma County General Plan requires all land development, including grading and fills, to "minimize any increase in drainage runoff, soil erosion, and downstream flooding and siltation" (DRAFT 12).

These are the existing constraints. Although the federal grant carrot is no longer as sweet as it used to be, there is still a strong incentive for local agencies to apply a flood plain management program. Namely, flood insurance is available to homeowners in communities with adequate ordinances.

What do homeowners think about living in flood hazard areas? In a survey of floodplain residents, the actions seen to be least useful in reducing neighborhood flooding were all non structural: government purchase of homes, government aquisition of the floodplain, transfer of development rights, and restriction of density. Ironically, more than half those surveyed believed that development was exacerbating flooding problems. (Laska 457)

The question still remains: how successful are these existing constraints in keeping our flood plain functional? The FEMA study that established Cotati's insurance rates did not delineate a floodway in my neighborhood, although the channel is only about one hundred feet from my foundation. The study also stated that no land use change was anticipated for the next 30 years. The reality is that the pasture was subdivided and built on, less than six years later. That same study also says: "Encroachment on flood plains, such as artificial fill, reduces the flood carrying capacity, and increases flood heights, thus increasing flood hazards in areas beyond the encroachment itself" (FLOOD 3). The regulations concerning changes in the flood plain clearly state that it must be proven that any land fill has not resulted in any floodway encroachment (44 CFR 65). Policies SE-2k through m, in the current draft of the Sonoma County General Plan, make it clear that encroachment on the flood plain should be limited (DRAFT 12).

Early flood plain ordinances took no account of the effect of project induced growth and the associated land enhancement benefit, and it is this very growth effect that has been largely responsible for increased flood damages. Man's activities on the floodplains have modified the natural conditions of the floodways, and often the net result of such human intervention is felt not only in the channel itself, but also throughout the drainage basin. Often the net effect of such changes has been increased flood depths, extending the original limits of the overflow area.

Should the 100-year flood frequency be the standard for zoning ordinances? To comply with the NFIP, and keep insurance available for homeowners, this must be the minimum standard. The long term solution to the flood damage problem in the highest flood risk zones would often be a conversion of the land to other uses. All construction in the designated floodway should be prohibited, to allow passage of major floods without unduly raising upstream water surface elevations. Controls in the floodway fringe may include limiting the type of land use, filling the land, and elevating structures. As a valuable adjunct to flood insurance, land use planning of flood hazard areas must keep development out of areas where flood risks are higher than probable gains.

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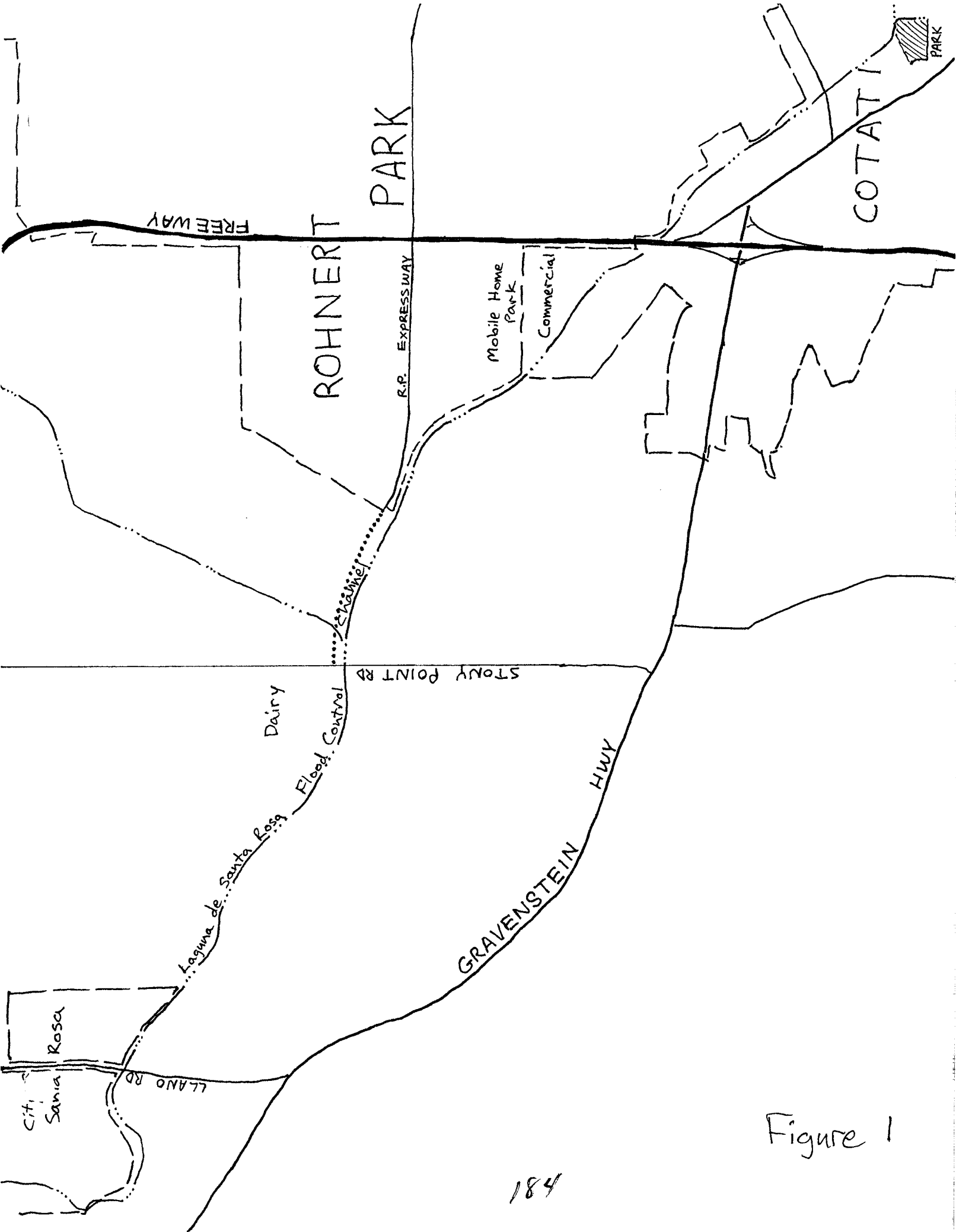


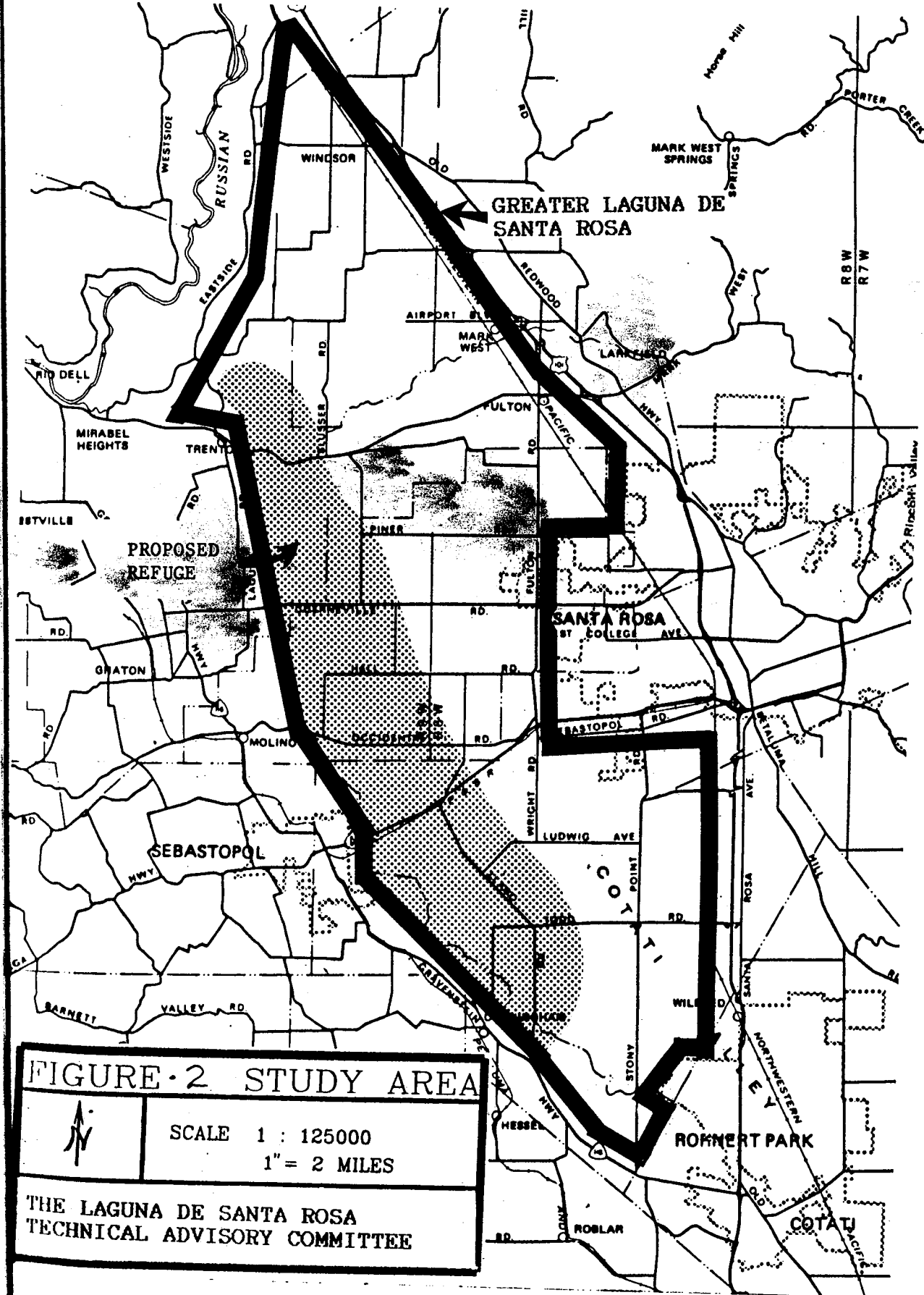
Figure 1

Creek flows under freeway, in the
 Sonoma County Water Agency.
 Manhole cover on the north side of
 de Santa Rosa Creek. Established by
 CV.
 Railroad spike on creek side of 4-100
 of Laguna de Santa Rosa Creek and
 approximately 500 feet north of East C
 Sonoma County Water Agency.

RM13 100.8
 RM14 103.3



Figure 2



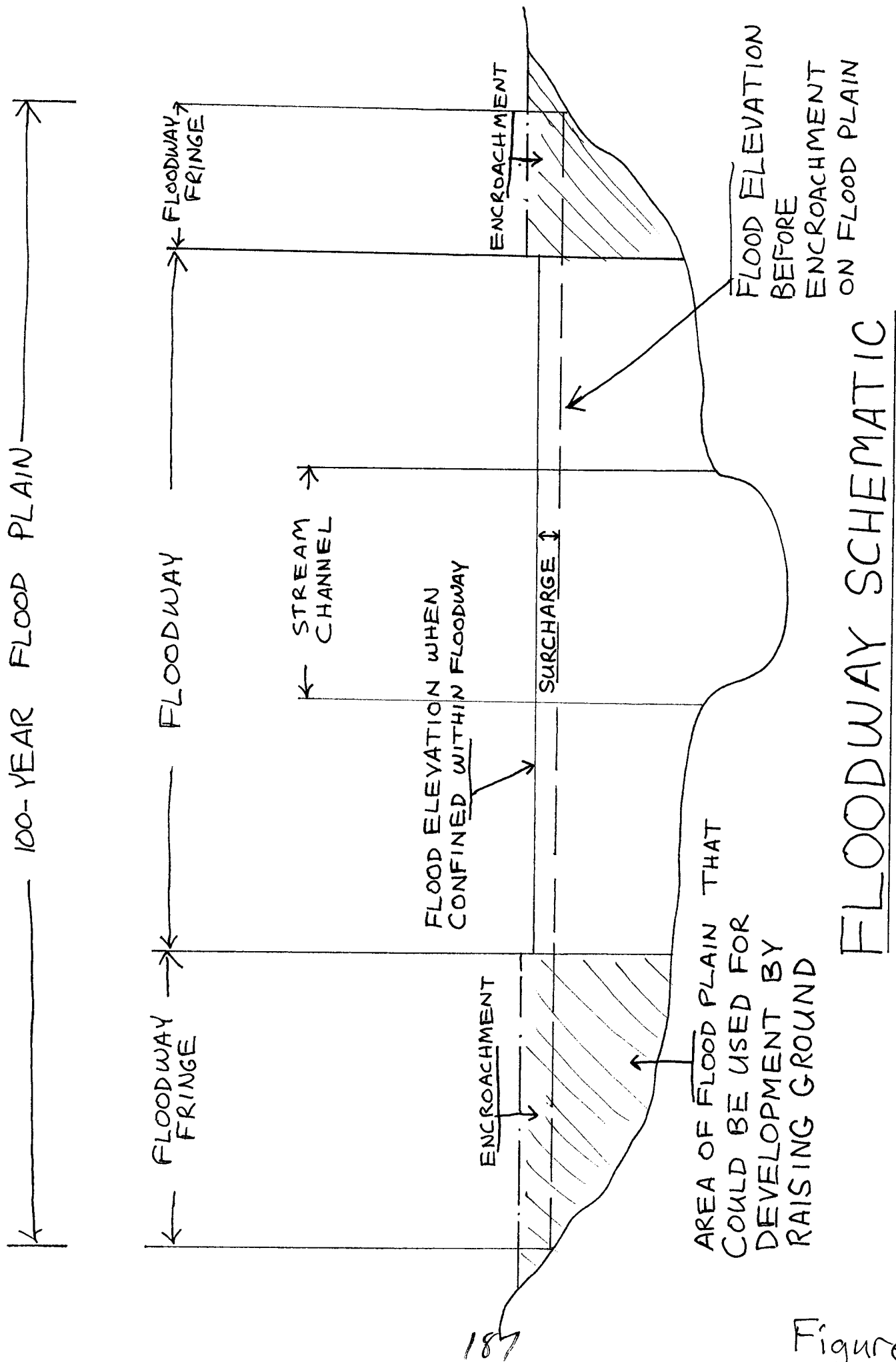


Figure 4

A PLANNING REVIEW OF THE PROPOSED LAGUNA DE SANTA ROSA WILDLIFE
REFUGE

Patrick A. Huggins

May 20, 1989

A Planning Review Of The Restoration Report For The Laguna De Santa

Rosa

By: Patrick Huggins

The proposed Laguna Wildlife Refuge is an attempt to return to nature what man has taken away. But, nature will not be able to maintain the refuge unless some of the refuge plan is strengthened. The plan calls for the purchase of land, re-introduction of native plants and animals, and the creation of a beautiful nature preserve. The plan does nothing to ensure compatibility with adjacent lands, nor does it ensure that the natural systems of the refuge will be preserved from man-caused damage. The following addresses some of the missing elements of the refuge plan, and provides some ideas to correct the plans shortcomings.

It is important to identify the adjacent land uses in order to properly provide for the interaction of these adjacent land uses with the refuge. The landuses adjacent to the proposed refuge boundaries vary greatly from intensive urban uses to the west of the refuge, to less dense, more intense agricultural uses to the east. Nature does not recognise parcel boundaries, so land uses adjacent to parcel boundaries must recognise nature.

The prominent land use on the eastern border of the proposed refuge is agriculture. Of the agricultural uses, cattle grazing is the most common, with some sheep and horse grazing, found in the adjacent parcels. The grazing animals, by themselves, pose no

threat to the natural systems of the refuge. As the subject of an agricultural business (large numbers) the livestock threaten the natural soils and waterways This is a direct result of their feeding patterns, and waste production ¹.

To the west of the refuge, the most promenant land use is urban type development. This development is a serious threat to the naturalness of the refuge. It poses two different types of threats to the refuge. The first threat is land consumption. If the outward expansion of Sebastopol, and Santa Rosa, is not controled, the refuge will not be able to maintain its natural systems, and thus will fail to achieve the refuge plans goals. The second threat attributed to urban development, near the refuge, is the threat of human caused pollution. This includes all forms of pollution; trash, urban runoff, and veg@titation changes. This last one is the changing, or removing, of veg@tation which results in the destruction of the natural system of the refuge.

The third land use which will effect the proposed refuge is really a subcategory, but because it occurs so often within the refuge it deserves special notation. This land use is roadways. According to the refuge plan, at least seventeen roads will cross, or run adjacent to the refuge boundries. These roads, left unchanged, will severly threaten the quality of the refuge. These roads will introduce large amounts of pollution into the refuge areas addjacent to the roads. As a result, the natural system of

0-100

the refuge may become a series of small, incomplete, mini spheres of nature.

When compared to the goals of the refuge plan, the adjacent land uses are not compatible. In each case the adjacent land uses will introduce pollution into the refuge. Regardless of the good intentions of the refuge planners, without some sort of controls on the periphery influences, the natural system of the refuge will never be achieved.

To achieve the desired natural results, the Sonoma County Planning Office, and the Sebastopol Planning Office, will need to take some responsibility for the periphery influences on the refuge. The planning offices should immediately begin a process of reviewing land uses to ensure that the land uses will have no adverse effect on refuge. This review should be based on the method introduced in Ian McHarg's book, "Design with Nature" 2. This system compiles all the important environmental information for a parcel into a visual data bank. Each piece of data is colored onto an overlay of the parcel. After all the overlays are completed, they are stacked on top of each other. With this completed, the location for non-detrimental development is clearly shown.

For agricultural land uses, the McHarg system will be too restrictive. Agricultural land uses should ~~should~~ be required to maintain a buffer between the refuge and their land use. A buffer system similar to the one recommended in the book "Performance

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Diminishing Lands, Diminishing Wildlife

Jeff Nagel

Biological Environment

ENSP 321

5-18-89

Dr. Jean Merriman

Introduction

The Laguna de Santa Rosa: Where is it? What is it? Why is it there? How does it work? And why should we be concerned with it? These were all questions I asked myself entering Dr. Jean Merriman's Biological Environment class. I realized after the first day of class and various field trips - that brought me the visual picture of the Laguna de Santa Rosa - that this was a vital wetland area in dire need for preservation and restoration and that I was going to take an active part in an attempt at preserving this laguna.

The Laguna de Santa Rosa is the second largest freshwater wetland in Northern California; Clear Lake being the largest. The Laguna is said to encompass anywhere between 7,422-64,000 acres, a system of wetland and upland habitats. At one time this laguna was a vast expansion of marshland, with a sufficient area of open freshwater that formed a complex chain of lakes.(4) Now, however, the laguna is being encroached upon by development, agriculture, and pollution, ever decreasing it's size.

The United States has less than half of the 215 million acres of wetlands that existed at the time of the European Settlement; of the approximately ~~99 million acres of wetlands~~ remaining, an area the size of California, nearly 93.7 million acres are freshwater wetlands.(1) These wetlands are prime spawning areas for fish, nesting grounds for waterfowl, and food sources for a wide variety of wildlife. In the lower 48

states, about 458,000 acres of the vital wetlands are lost annually to farming, development (urbanization caused by population growth), and pollution;(5) and as these wetlands decline, so too has certain wildlife.

The main purpose I have for this report is to inform others on how valuable these wetlands are, the Laguna de Santa Rosa in specific, and the significant wildlife they support. This report will also cover the problems of how we are isolating our wildlife species out of existence and the positive impact a sizeable refuge will give to the preservation and restoration of the wildlife in the Laguna de Santa Rosa.

Without Wetlands, you are Without Wildlife

Searching through the current data on the Laguna de Santa Rosa, such as reports from the Technical Advisory Committee, Press Democrat, and reports from the fall semester's ENSP 321 class, along with field trips, lectures, and periodicals on wetlands and wildlife, I found my main interest. That interest is on what the wildlife is to do if the wetlands vanish, and where will they go when they become increasingly isolated away from their habitat.

Wetlands are treated by some people as more of a nuisance rather than as a valuable resource.(12) These people consider the wetlands as wastelands and simply useless unless they are drained and filled for the development of real estate and/or farmland. These areas unfortunately, usually don't attract the romantic image of a wilderness area, with the majestic mountains and enormous trees.(5) Some people simply don't realize that the wetlands are an extremely effective means of flood control, that they help in the recharge and purification of groundwater, removal of tough pollutants such as nitrates and phosphates, control erosion, collection and recycling of nutrients, and work as chemical sinks.(11) The wetlands also provide aesthetic and open space benefits, along with supporting numbers of endangered birds, mammals, amphibians, fishes, and plants. These areas allow for a protective habitat for up to one third of all

endangered animal species.(11) Inevitably, use and abuse has taken its share of wetlands, such as the Laguna de Santa Rosa, drastically affecting the animal habitat and the animal life incorporated within this complex ecological system.

Bill Cox, fishery biologist for the California Department of Fish and Game, states that the diversity in the Laguna de Santa Rosa has been lost and the system is much simpler now.(2) This abundance and diversity of habitat and wildlife diminished as early as the 1830's when there was a sudden grazing trend of thousands of cattle on the Spanish Rancho.(4) The Laguna, at one time, supported the bald eagle and peregrin falcon, now on the federally endangered species list, along with the California freshwater shrimp. The laguna provides habitat to support a total of four state and/or federal listed endangered animal species.(4) The laguna also was an important nursery for salmon and steelhead, where it now holds many introduced species, such as the largemouth bass, karp, goldfish, and others, totaling some 19 species.(2) Once numbering in the hundreds of thousands, wintering waterfowl in the Laguna de Santa Rosa now number between 3,000 and 5,000.(4) Therefore, the laguna is an important wintering and nesting area for these migratory waterfowl and is a key area in waterfowl habitat along the federally managed Pacific Flyway.

The U.S. Fish and Wildlife Service believes this Northern region of California is one of the most important wintering areas for waterfowl in the nation. Nearly 60% of the Pacific

Flyways waterfowl winter here-18% of North America's wintering waterfowl.(5) The U.S. and Canada along with state governments and private conservation groups, have signed an agreement directed at rebuilding the North American waterfowl flocks by the year 2000, to their levels of a decade ago. This goal, at some \$1.5 billion, lies in halting the destruction of wetlands and purchasing and restoring the prime habitat-some 5.6 million acres in all.(8) Jerry Serie, a U.S. Fish and Wildlife Service biologist said, "The ancient migratory routes are what tie this continent together."(5)

Other species as well, are important to the future of the Laguna de Santa Rosa. Species are involved in providing our society with indispensable and irreplaceable "ecosystem services". These services include the maintenance of the quality of the atmosphere, disposal of wastes and recycling of nutrients essential to agriculture, generation and maintenance of soils, support a vast genetic "library" from which we can use. This list continues on more extensively.(3) Some organisms that live in the mud and on the plants of the marsh act as a filter for wastewater that enters into the laguna, while the effluent nutrients add to the richness of the ecological system.(7) So within this native wetland, the plants and animals live together and will not survive major; or for some minor, disruption within and around the laguna.

The National Wildlife Refuge System dates back to 1903, when President Theodore Roosevelt created this countries first

refuge at Pelican Island, Florida to protect its bird species. Turning the Arcata marsh area in Northern California into a refuge recently, serves now as an important rest stop for the birds migrating along the Pacific Flyway. More than twice as many bird species now use this marsh as did in the past.(7) However, because we have established so few parks of suitable size, and because our options for establishing any new parks are running low, some observers feel we could lose many if not most of our large mammals and birds in a few thousand years.(6) A few thousand years may appear long to some, but in a geological conservation perspective, this is a blink of the evolutionary eye.(6) It takes much longer for one species to be created than for many species to be destroyed.

In January of 1989, Congressman Doug Bosco proposed a plan to protect the Laguna de Santa Rosa by making it a National Wildlife Refuge. His proposal was to create some 9,000 acres of U.S. wildlife reserve in the laguna to save what is left of this marshland before it is completely engulfed by urban growth. Ralph Opp, biologist with the Oregon Department of Fish and Wildlife, believes that these refuges play an important role in the Pacific Flyway. "We're down nearly 10% of the historic populations of waterfowl in the Flyway, and we would hate to lose another acre of wetlands."(10) Since habitat loss is a major concern, the refuges focus much emphasis towards this area. If these refuges are going to be successful though, they cannot be bound by the signs that mark the refuge boundaries.

This idea leads into the theory on Island Biogeography.

Island Biogeography is a relatively recent(1963) theory that envisions communities of species on "islands" as dynamic entities, with a number of species extinguished on each island per unit time and a number of species immigrating to these areas per unit time. According to this theory, the number of immigrant species eventually (thousands of years) equals the number of extinguished species, and therefore achieving some equilibrium.(9) However, an "island" can support only so much life - viable carrying capacity. So, if 90% of an original habitat is severely disrupted and the remaining 10% is protected and managed, one can expect to save no more than half the species in that area.(6) Even these well protected areas will slowly lose some of their species, as this habitat destruction isolates the wildlife. So, the larger an area is protected, the longer it will likely take for any species to disappear, for the reasons that relate to the idea of a minimum viable carrying capacity.

Diminishing habitat raises a red flag in warning the nation for the future.(5) "Waterfowl are a barometer of the ecological health of the continent," explains Matthew Connolly, ex. Vice President of the conservation organization Ducks Unlimited.(8) Dr. Frank Bellrose, waterfowl biologist of North America, agrees that habitat destruction is is the most crucial by stating, "Their dwindling numbers reflect assaults on the environment of many different fronts: acid rain, pesticides, but most of

all the destruction of millions of acres of ecologically priceless wetlands. Poisoning tends to be an acute temporary problem while the bigger problem, the old chronic problem, continues to be the loss of prime waterfowl habitats up and down the Pacific Flyways."(5) As these ancient wetlands drain away, so too does the wildlife it supports.

Conclusion

Since we know that many reserves today are almost certainly too small to permanently support the large animals and life they were designed to maintain, everything possible should be done to turn non-reserve areas into more hospitable regions for other species. Native vegetation should be planted to replace lawns and manicured parks, concrete lining of streams should cease, herbiciding of roadways should be forbidden, hedgerows should be planted between farms, and the list continues.(3) Programs on ecosystem reestablishment should be started everywhere turning to nature these marginal farm lands and overgrazed ranges, deserted slums and old railroad tracks, and so forth, creating ideally some corridors of restored habitat to allow migration between the reserves.(8)

Although there has been much habitat loss in the laguna, we must restore it now or we will lose this wetland forever. It is clear that every attempt must be made to increase the number and size of nature preserves now. Let's not wait to

react to this problem, but rather act now and reduce the
unfortunate losses. As Dr. Jean Merriman told me once,
"Extinction is Forever."

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BIOLOGICAL SEWAGE TREATMENT:

a Sensible Step Towards the Future

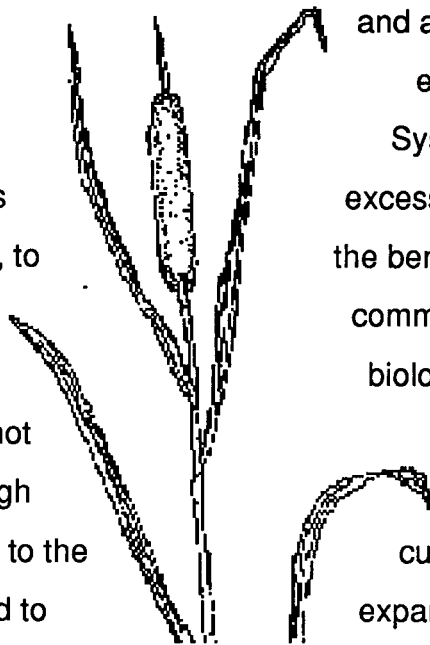
by

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Environmental Studies and Planning 321
The Biological Environment
Dr. Jean A. Merriman
May 23, 1989

The Laguna de Santa Rosa: Sonoma County's most precious body of water.

The fourteen mile stretch of waterway beginning near the Cotati/Rohnert Park area and meandering northward to the Russian River, is the home to a variety of plant and animal species, many of which are increasingly threatened with extinction. The Santa Rosa Subregional Wastewater Treatment Facility which often dumps excess treated sewage into the Laguna de Santa Rosa, and leaves it there, to the benefit of no one. The Laguna could be used to the benefit of the community as well as the environment with the implementation of a biological wastewater treatment plant. While a biological system would not feasibly replace the existing treatment system because of the high volume of waste, it could be well implemented as an expansion to the current system. The use of a system such as this would avoid the need to expand the Laguna Sewage Treatment Facility, thus eliminating an increase of the dangerous chemicals used in its process. A wetland integrated with the biological system would not only benefit the citizens of the



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community, but would enhance the Laguna environment as well.

Contained within the 160,000 acres of the Laguna de Santa Rosa are vernal pools which, with the exception of the few that remain in Africa, the high plains of Chile and southern Oregon, exist solely in California. The vernal pools support the life of many rare native plant species which seem only capable of survival in the unique micro-environment offered by the vernal pools. When one looks a little further into the diversity of the vernal pools, it is easily noticeable that they are more than "just a mud puddle."

Just as with vernal pools, the wetlands of the world are disappearing. Whether it is caused by bulldozers, channelization or pollution, the wetlands of the world are being destroyed at an alarming rate. Approximately 90 percent of all wetlands have been destroyed within the last 150 years¹, with most of the damage due to the careless, anthropocentric attitude held by much of humankind.

In Sonoma County, the Laguna is faced with similar pressures. It has already been channelized to increase the draining capabilities and lengthen the agricultural season for the local farmers. It has been filled in, built over, and dumped on for the last 100 years or so since the Pomo Indians last inhabited the area.

One of the potential contributors to the ills of the Laguna de Santa Rosa is the Laguna Sewage Treatment Plant. The Laguna Plant and two smaller plants (Oakmont and West College), along with the 1.5 billion gallons of effluent storage ponds, make up what is known as the Santa Rosa Regional Waste Water Treatment Plant and Disposal System. The Oakmont Wastewater Treatment Plant operates May through October at about 0.65 mgd (million gallons a day), using the treated effluent to irrigate the Oakmont Golf Course². The West College Plant on the other hand, operates

mainly during the wet season (if any) to reduce the load on the Laguna Plant, and during dry seasons for small amounts of irrigation.

The Laguna Treatment Plant contains many of the latest practices in its tertiary treatment system, developing an end product that carries little adverse impacts when used to irrigate 5,500 acres of land around the county. The current 15 mgd the system pumps out during the summer months is not nearly enough to supply the 25 mgd demand generated by the agricultural land. This requires that water be taken from the various storage ponds along the length of the Laguna between Cotati and Guernville Road.

The techniques used at the Laguna Treatment Plant, as with all advanced treatment facilities of its type, are extremely energy and chemical intensive. While the final effluent is a quality product, able to pass many of the EPA standards for drinking water³, the process of obtaining this quality carries many potential environmental hazards. For example, early in the Laguna Plants treatment process, ferrous chloride is added to the raw sewage to aid in the digestion of sludge and decrease the emissions let off into the atmosphere by reducing the hydrogen sulfide. The raw sewage is then pumped through grit chambers where inorganics such as sand and dirt are collected and later trucked to the Central landfill. The organic materials then flow to the primary sedimentation where the grease separates from the organics. The grease is sent through sludge digesters and is later dewatered and also trucked to the landfill. The organic matter continues through aeration tanks where, if everything works correctly, the microorganisms present consume much of the waste. Aluminum sulphate is then added at a rate of 5g/l as a coagulant which precipitates out the phosphates. After travelling through the anthracite coal filters, the effluent is then

chlorinated for the final disinfection, after which any excess chlorine is inactivated by sulphur dioxide. From here the treated effluent is either pumped to the storage ponds or straight into the Laguna.

Looking at the final product the treatment system develops, it is not all that bad, especially considering the enormous volume of effluent treated each day. But as one looks into the various steps along the way, we see a process that could keep Pacific Gas and Electric smiling and make Nancy Reagan "just say no."

First consider the overall energy demand. The energy required to pump the 18 to 27 million gallons of sewage every day into the facility, through the entire system, and down the 15 miles of transmission pipes to the storage ponds⁴, is very difficult to conceptualize. If this isn't enough, then consider the energy required to stir, heat and aerate the secondary vats, with the entire system operating 24 hours a day, 365 days of the year. During a "dry flow" month (18 mgd), the Laguna Treatment facility requires about 22,000 kwh/day (kilo-watt hours per day) to operate. During a "wet flow" month the plant will use almost 30,000 kwh/day⁴. At a rate of \$.08/kwh over a period of a month, this would create an electricity bill of \$72,000!

As with all fossil fuel-dependant systems, the Laguna Treatment Plant continues to place undue stress on the natural environment. In addition to this, modern society continues to believe the fallacy that non-renewable fuel sources are exclusively "Long-Term". This is demonstrated in the report put out by CH2M HILL for the future plan of the Santa Rosa Subregional Water Reclamation System. The report titled *Long Term Detailed Studies* demonstrates that the alternative systems being proposed will be operative through the year 2010⁵, but who really knows if we will have the fuel to support such claims? And assuming the worlds fuel supply is still sufficient, how long

can the natural environment hold up against the continual abuse placed upon it by modern society? As the Exxon corporation demonstrated to the world in Valdez, Alaska, the price we pay for energy *is not* determined by the cost at the gas pump.

Now consider the "chemical dependency" of this system and the many others that are present in our world today. In the sewage treatment industry it seems the way to meet regulations on some chemicals is by using other chemicals which are not regulated⁶. Chlorine is used to meet ammonia standards, and in the process makes chloroform and chloramine, which are not regulated. Aluminum is used to eliminate phosphates. Aluminum, however, remains toxic in all parts of the environment. The use of sulphur dioxide to inactivate the excess chlorine inadvertently combines with the chlorine to produce chloride salts⁷ (a nasty chlorine compound). While sewage treatment facilities play the "regulation game," chlorine and its organic compounds are damaging the environment. One such compound, chloramine, is a carcinogen, and still another are chlorofluorocarbons, which are destroying the ozone layer. In addition to these, many chlorine compounds are unable to be broken down by natural organisms⁸, leading to the possibility of biological magnification within the Laguna de Santa Rosa ecosystem⁹.

While the vast number of sewage treatment facilities continue to operate with a high demand for these and other chemicals, a few systems have more recently emerged using biological treatment for purification. This process succeeds by mimicking a part of the nitrogen cycle found naturally in the environment. Essentially what occurs, is the raw sewage is screened to remove the larger debris and inorganic material, similar to a conventional treatment plant. Next it is aerated, where light, air and pond bacteria begin to digest the organic components and nitrify the ammonia.

From here the sewage enters the pool or marsh environment. The bacteria living on the plants (whether they are water hyacinths, cattails or whatever) and in the soil and water, break down to dissolve the organic matter, transforming ammonia into nitrate. The nitrate is then used by the plants as food, which are in turn eaten by animals. Animal waste contains ammonia, thus allowing the cycle to continue. While this example of the biological treatment system is extremely simplified, it demonstrates that the nitrogen cycle (one of six biogeochemical cycles) is the basis for success in all biological waste treatment systems.

One example of a system using biological treatment is the City of San Diego's Aqua Culture Plant, which uses water hyacinths growing in six quarter-acre ponds to clean up 300,000 gallons of sewage a day, with the ultimate goal being the production of a water suitable for human consumption^{10,11}. Another example is the Arcata Marsh and Wildlife Sanctuary, which was completed in 1981, and came into conjunction with the existing sewage treatment system in 1986 as a way to make the existing system both environmentally and economically sound¹². The 94 acres of fresh and saltwater marshes not only provides sewage treatment for almost 15,000 Arcata residents, but also supports a large population of local and migratory waterfowl.

Perhaps the best development for "long range" sewage treatment, however, is the solar-aquatic treatment plant brought forth by John and Nancy Todd, who co-founded the New Alchemy Institute on Cape Cod, Massachusetts, in the late 1960's. The New Alchemy motto; *"To restore the lands, protect the seas, and inform the earths stewards"*, has remained unchanged throughout the years, being well represented by many ecologically sound developments such as the solar aquatic waste facility. The Todd's continually preach the need for designs that follow the "Laws of Life," are

coevolutionary with the natural world, and are based on renewable energy sources. Their sewage treatment design is based on the use of solar energy and the nitrogen cycle for purifying the water. While it remains similar to other biological plants in most respects, it has been shown to be able to operate during the winter months in Sugarbush, Vermont, where the days are short and the temperature remains around zero. The reason for its ability to operate under these conditions is due to its unique bioshelter environment: a solar sewage treatment facility. The 27-by-32 foot bioshelter enables 3,000 gallons of effluent to be treated each day, while consuming little energy and using no chemicals in the process. In addition, the facility is able to harvest the plants and trap the methane gas for energy production. The aquatic plants used to purify the sewage can also be harvested as a soil amendment or be used for their aesthetic quality. The final stage within the solar treatment plant is a fish hatchery which makes use of the solar heated, purified, and sterilized sewage water.

I'm not suggesting that the present Laguna treatment facility be scrapped and a biological treatment facility be erected in its place. I am suggesting, however, that the proposed "Long-Term" waste treatment plants are not the best solution for the community or the environment, and should be reconsidered for the long term. A more sensible treatment system would consider all factors involved in and around the sewage treatment plant, and integrate as many of the variables as possible. The initial step would have to be a reduction in the current sewage demand, stemming from a county-wide water conservation plan. This would probably entail mandatory water limits at residential and commercial levels, installation of water conservation devices in all structures, and charging users for the actual amount of water being consumed. Since Sonoma County has essentially done nothing to promote conservation up to this

point, a county wide conservation measure would greatly reduce the current usage, and thus decrease the demand on the entire Santa Rosa Sewage Treatment System. By substantially reducing the demand on the system, it would then become beneficial to further expand using biological waste treatment systems.

As demonstrated by the Arcata Marsh and Wildlife Sanctuary, a biological treatment system can mutually benefit both the people of a community and the environment in which they live. By using the treated effluent as a resource, the communities of Sebastopol and Cotati could create their own successful wetland area. A wetland in this area would benefit the natural system in and around the Laguna de Santa Rosa, while helping to solve the ever increasing sewage dilemma.



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By reestablishing a freshwater marsh as part of the Laguna environment, it could once again thrive as it did when the Pomo were the only people to call this place Home. A lush riparian habitat would keep the waters of the Laguna cool, thus enabling the salmon to return as they did so many years ago. The waterfowl could nest amongst the rich vegetation and fish in the shallows near shore. The citizens of the community could then speak affectionately of their treatment system, proudly displaying the environment it helped to restore.

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Reclaimed Water and the
Laguna de Santa Rosa

by Jason Rose

ENSP 321, Laguna study
Dr. Jean Merriman

Introduction

I began my Laguna study with an interest in an examination of the possibilities for groundwater recharge, using reclaimed water. My intention was to show that reclaimed water could be partially diverted away from storage in the Laguna during the winter, when a large volume of surface water appears due to precipitation. In addition, I conjectured that partially-treated wastewater could receive additional treatment naturally (through soil percolation), and might possibly be suitable for drinking.

As I made contact with officials from the community, and gained exposure to the research that had already been completed, I shifted the focus of the paper several times. I learned that groundwater and surface water recharge proposals involve limiting factors in Sonoma County that render them unworkable. Limitations have to do with a lack of suitable soils (well-drained), and health concerns.

Whereas research points to a need for planning in relation to water use, the workable alternative in practice is likely to be water conservation as opposed to recharge. The culmination of current research in Sonoma County is to propose using reclaimed water for landscape and agricultural irrigation, which would result in conservation of groundwater resources.

The focus of this study is the recent and current research on reclaimed water use, and the potential impacts related to the Laguna de Santa Rosa. The reclamation studies are comprehensive in scope and have the potential for addressing a variety of con-

cerns: landscape/agricultural irrigation needs, groundwater conservation, wildlife habitat enhancement, and drinking water quality.

The Potential of Reclamation

Since awareness of the value of an undisturbed Laguna de Santa Rosa has increased over the last several decades, broad concerns and proposals have become more specific. In 1977, the Sonoma ^{state U.} ~~County~~ Planning Department (DeMars, et al) conducted a study that identified water quality problems in the Laguna, and proposed a direction for management in the region. Reclamation and reuse was presented as a primary goal for management, and that direction has been expanded upon in the current studies. In the close of the introduction, I have outlined four areas that should be influenced by the research.

For at least one city ~~area~~ of Sonoma County, it is apparent that groundwater levels are approaching overdraft.¹ Rohnert Park city council member, David Eck asserts that planning is necessary in light of growth trends: there will be a need for more than the present reliance on groundwater. Eck explained that there is some concern about cones of depression in drought years, as projected for the future.² John Bond, of Sonoma State University Plant Operations, attested that aquifer levels dropped in the summer of 1988, to the point where the water column had to be extended.³ Recovery of campus wells is diminishing, and this has instilled a desire to augment existing water sources.

Although groundwater recharge seems an attractive alternative, the option is limited in terms of sites available with well-

drained soils. Dan Carlson, of the Santa Rosa Utilities Department, indicated that one of the areas (near Windsor, along the Russian River) was the target of a recharge proposal called rapid infiltration (RI). According to this proposal, tertiary-treated wastewater is "polished" through soil filtration, and ultimately would contribute to the Russian River aquaduct water supply.⁴ This alternative, then, does not constitute a recharge to groundwater.

Moreover, the RI proposal was deemed unacceptable by the California Department of Health Services- the area subject to discharge is not as yet affected by reclaimed water. The job of testing for viruses is a process of elimination, where analytical capabilities are limited. Therefore, the siting is considered risky, particularly in light of the Russian River wastewater controversy of the winter of 1985.⁵

John Bond and David Eck directed my attention to the preliminary studies on water reclamation, which include research on the use of reclaimed water for irrigation.⁶ At present, the SSU campus and the city of Rohnert Park have expressed interest in making a commitment to using reclaimed water for landscape and agricultural irrigation. Contract negotiations are ongoing between the Sonoma County Water Agency and Rohnert Park, to assess the cost of extending a pipeline from Poncia pond (along the Laguna and Copeland Creek) to meet irrigation needs in the Rohnert Park area (eastward to Petaluma Hill Road). Dan Carlson explained that the reclamation proposal for Rohnert Park would remove the need for drawing on groundwater for irrigation;⁷ conservation would

therefore serve the same purpose as recharge. David Eck projected that there will be a high demand for reclaimed water in the future; further, reclaimed water use is expected to match groundwater conservation at a ratio of one to one. At that point, I directed my research to focus on the four-volume reclamation studies, which were provided by Dan Carlson.

I began with a reading of tech memo R4- information from that study includes the standards and guidelines set for unrestricted reuse.⁸ The standard set for subregional treatment in January 1989 is such that irrigation may include all types of crops, including fruits and vegetables that may be eaten raw.⁹ Table R4-4 shows that reclaimed water quality matches/exceeds the standards set for irrigation water quality (for inorganic constituents).

My concern at that point had to do with the pollutive effects of irrigation runoff, in terms of heat, eutrophication, viruses, and other elements not explicitly mentioned in the report. Some of these pollutants would affect fish and wildlife habitats; viruses could be carried through to surface water (from non-point sources, such as dairy runoff) and present a human health problem. I spoke with Gary Nuss, a CH2MHill consultant who coauthored tech memo R4. Nuss explained that irrigation runoff can be minimized with adequate management, and that the criteria for management was included in the first Reuse tech memo. This memo was useful as a general outline for the proposed irrigation expansion plan.

The sites proposed for irrigation expansion are Sebastopol, the Stemple/Americano creeks area, and Rohnert Park. In the first

two areas, irrigation is likely to include both agricultural and landscape service, whereas Rohnert Park will rely primarily on landscape irrigation. Sebastopol has two reservoir sites, with a total capacity of 4115 million gallons; the Stemple Americano area has four reservoirs, with a storage capacity of between 3300 and 6500 million gallons;¹⁰ and Rohnert Park currently has a 1200 million gallon capacity, coming from three main ponds.¹¹

Many of the conditions set for reclaimed water irrigation address concerns about virus contamination. They include¹² requiring site slopes of less than 15%; air gap separation between potable and reclaimed water lines; and a buffer zone of 50 feet between irrigation sites and wells. The treatment process described in Table R4-3 yield a coliform count of 2.2 organisms per 100 milliliters. According to EPA standards, this count is well below the standard set for drinking water, which is one colony per 100 milliliters.¹³

Volume L is a useful source for analyzing the impact of discharges on fish and wildlife habitats. The goal as presented by the report is to minimize adverse impacts of irrigation discharges, and to enhance the Laguna habitat through restoration. The report is limited in the sense that it analyzes present conditions (which are already affected by eutrophication and certain inorganic pollutants) while projecting what level of impact further discharges will create. For example, the report lists the range of fish typical of eutrophic waters, and refers to them as the resident species to be protected.¹⁴ However, it is also im-

portant to note that the Laguna sustained a larger range of fish types (such as salmon and steelhead), in its less disturbed state 100 years ago.¹⁵ To its credit, the report also addresses the important issue of habitat restoration, which would constitute more than mitigation of present conditions (this is covered in a following paragraph).

The first tech memo of volume L identifies non-point source pollution as a primary source of inorganic pollutants such as ammonia,¹⁶ which in turn stimulate algal blooms in the Laguna. Apparently, discharge is not a significant factor in the levels of ammonia, nitrate or phosphorous found in the wetland region. The highest concentrations of ammonia have been found in the upper Laguna, above the primary locale for reclaimed water discharge. Theoretical calculations based on a 1985-1988 study period show that ammonia concentrations could be reduced by 50-60% in the lower Laguna if concentrations in the discharge are lowered from 12 mg-N/l to 5 mg-N/l.¹⁷ Now that the nitrification process of reclamation is online (Table R4-3), effluent is expected to comply with the lower concentration. Another related problem is BOD, which can be traced to algal respiration. Dissolved oxygen levels have been ~~at~~ the lower end of tolerance for anadromous fish (such as migrating salmonids) in recent years; this condition is also expected to improve with the current filtration process, which will reduce BOD.

Q1 > As to continued discharges into the Laguna, the report projects a number of benefits as well as adverse effects. Areas to be mitigated are algal growth and lowered dissolved oxygen levels; ammonia toxicity and traceable metals; and the effect of discharge on fish

migration. Some of the benefits offered are increased flow, which will facilitate flushing of pollutants during low flow periods; and the creation of a wetland habitat.

The latter goal will be aided by restoration efforts, which are an element of the current phase of studies. The irrigation expansion plan proposes 150-250 acres of "constucted ribbon wetlands" along the Americano Creek,¹⁸ and additional "habitat enhancement releases" of treated water in ephemeral streams of the Laguna. Releases are planned to occur between October 1 and May 14, between 5-7 times during the rainy season. The amount released will be a portion of the allowable discharge under the NPDES permit.¹⁹ This planning is intended to improve the wildlife habitats of the Laguna and the Americano, which are valued more as a wildlife than a fish resource, according to Bill Cox. It is promising that the current studies include the feasibility of replacing historical wetlands (Gary Nuss).

Conclusions

An optimum proposal will deal with a range of concerns connected with the Laguna, including water resource levels and quality, and wildlife preservation. The reclamation/reuse studies are thorough in a number of respects, touching on the preceding issues as well as the needs of irrigating parties. Studies continue currently, with an emphasis on irrigation system design, riparian restoration and impacts of non-point source runoff. Other areas (recommended in the 1977 Laguna study) that might be worked on are public education (on the resource and economic value of reclaimed water), and an interest group of farmers, public works personnel

and an ag advisor, which could act as a mediating body to deal with field problems.

Footnotes

- 1) Tech memo R4-8
- 2) Phone conversation, April 17, 1989.
- 3) Spoke with, April 10, 1989.
- 4) Tech memo T24.
- 5) Steve Setoodeh, spoke with, March 23, 1989.
- 6) These studies consist of four volumes of technical memos published in February 1989, to develop the alternative of reclamation.
- 7) Phone conversation, April 19, 1989.
- 8) The standards were set by the State Department of Health Services (DHS) and the Food and Agricultural Organization of the U.N. (FAO).
- 9) See Table R4-3.
- 10) R1-41,53.
- 11) R4-9.
- 12) R1-9.
- 13) Miller, p.457.
- 14) L1-3.
- 15) Bill Cox, Department of Fish and Game, presentation at SSU, 2-16-89.
- 16) Non-point source pollution accounts for 80% of ammonia levels detected (L1-1).
- 17) L1-2.
- 18) R1-53.
- 19) National Pollution Discharge Elimination Systems.

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- 2) Dan Carlson, Santa Rosa Utilities Department. Spoke with by phone.
- 3) Dave Clark, Sanitary Engineer, Department of Health Services. Spoke with by phone.
- 4) David Eck, Rohnert Park city council member. Spoke with by phone.
- 5) Gary Nuss, Consultant, CH2MHill. Spoke with by phone.
- 6) Steve Setoodeh, Sanitary Engineer, Department of Health Services.
- 7) Miller, G.T. Jr. Living in the Environment. Belmont, Ca. Wadsworth Publishing Co. 1988.
- 8) DeMars, John, and others. Laguna de Santa Rosa Environmental Analysis and Management Plan, May 1977.
- 9) CH2MHill. Santa Rosa Subregional Water Reclamation System: Long-Term Studies (four volumes), February 1989.

Table R4-3
TREATMENT GUIDELINES FOR AGRICULTURAL
AND LANDSCAPE USES OF RECLAIMED WATER

<u>Type of Crop</u>	<u>Oxidized Disinfected to 2.2 MPN/100 ml^a</u>	<u>Oxidized, Coagulated, Clarified, Filtered, Disinfected to 2.2 MPN/100 ml^b</u>
Pasture	Surface or Spray	Surface or Spray
Silage and Hay	Surface or Spray	Surface or Spray
Seed Crops	Surface or Spray	Surface or Spray
Christmas Trees	Surface or Spray	Surface or Spray
Sod Farm	Surface or Spray	Surface or Spray
Vegetables-Extensive Processing	Surface or Spray (no gleaning)	Surface or Spray
Orchards/Vineyards	Surface or Spray (no gleaning)	Surface or Spray
Ornamental Nursery	Surface or Spray	Surface or Spray
Vegetables Eaten Raw	Not Allowed	Surface or Spray
Berries	Not Allowed	Surface or Spray
Landscape:		
1. Some Golf Courses ^c , Medians, Cemeteries	Surface or Spray	Surface or Spray
2. Some Golf Courses, Parks, Playgrounds	Not Allowed	Surface or Spray
3. Impoundments (Ponds)	No Body Contact	Unrestricted

^aPrevious Subregional System treatment level.

^bCurrent Subregional System treatment level (as of January 1989).

^cGolf courses with no houses along the fairways.

NON-POINT SOURCE POLLUTION IN THE LAGUNA DE SANTA ROSA

By Linda Christopher

NON POINT SOURCE POLLUTION IN THE LAGUNA DE SANTA ROSA

by Linda Christopher

INTRODUCTION

The Laguna de Santa Rosa provides beneficial uses such as ground water recharge, flood water storage and agricultural water supply. It is a wildlife habitat--harboring rare and endangered species--a route for migratory fish, an area of rare vernal pools, and an important stop for migratory birds along the Pacific Flyway. Yet, the ability of the laguna to offer these services is being impaired by degrading water quality. In fact, it is quite probably the most polluted segment of the Russian River watershed.(1) As in other aquatic systems, the pollutants entering the laguna are divided into the two categories as follows.

Point-source pollutants enter waterways from specific, identifiable locations, such as pipes and ditches from factories or sewage facilities. Non-point sources of pollution are discharged over a large area rather than a discernible site.

Despite effective regulation of point source discharges into the laguna, the California Water Resources Control Board reports that water quality impairment persists.(2) Therefore, the primary sources of pollution in the laguna are from non-point discharges from the surrounding land uses.(3)

NON-POINT SOURCE POLLUTION

As rain falls on the land and flows to streams, lakes and into the laguna, it picks up materials from the surfaces it flows

across. The kind of materials carried away by the runoff depends on the type of surface and the land use.

In cities large areas may be covered by impermeable asphalt and concrete, preventing percolation of water into the ground. Litter, waste, oil or grease may be flushed into aquatic systems by the water flow.(4) Surface runoff from highways and storm water drainage from urban areas constitute the greatest non-point pollution problems.(5)

In rural regions rain and flowing water erode exposed soil and carry plant matter, animal wastes and pesticides into waterways.(6)

There are seven categories of contaminants identified in surface runoff:(7)

** SEDIMENTATION AND EROSION

Sedimentation and erosion makes water turbid. It clogs streams, fills in reservoirs and increases the costs of drinking water treatment. It covers fish spawning beds and excessive sediment loads may damage freshwater organisms. Erosion and sedimentation may be caused by improper construction and agricultural practices that expose bare soil to rain and runoff. Other causes are the use of off-road recreational vehicles, erosion from road cuts, overgrazing, and the overuse of riparian areas.

** GREASE AND OIL

Grease and oil are not only unsightly, they make recreational use undesirable. They coat birds and fish, and are toxic to

aquatic life. They are present near metropolitan areas and heavily used roads. Their presence is attributed to automobile operation, industrial activity and illegal dumping of motor oil.

** LITTER AND DEBRIS

Litter and debris are unsightly. They, too, reduce the recreational value of the aquatic system, as well as diminish channel capacity, and are detrimental to birds and other animals that may ingest them. Litter and debris may originate from improper dumping and refuse disposal, or are washed off from areas where littering is prevalent.

** BACTERIAL CONTAMINATION

Bacteria can cause disease when humans come in contact with or ingest them. Therefore excessive bacteria counts in a waterway prohibits all recreational use. Bacteria will also contaminate aquatic life--especially shellfish. Bacterial contamination usually indicates the presence of fecal material and it enters our waterways from leaks in sanitary sewers, malfunctioning septic tanks and the deposit of fecal material from cats, dogs, rodents or livestock in areas subject to runoff.

** NUTRIENTS AND ALGAE GROWTH

Excessive nutrients spur algal blooms which create taste and odor in drinking water and diminish recreational use. The algae consumes oxygen in the water, rendering it unable to sustain aerobic life. Too much algae is harmful to the ecosystem, but is difficult to control once established in confined waters. Major

sources of nutrients in surface runoff are from fertilizers, animal wastes, automobile operation and soil particles.

** HEAVY METALS, PESTICIDES AND TOXIC CHEMICALS

Heavy metals, pesticides and toxic chemicals can kill or injure aquatic organisms. Some are known carcinogens. A large variety of complex and potentially dangerous chemicals are used in great quantities. Heavy metals, such as lead, mercury and zinc are deposited on impervious surfaces during such routine practices as automobile operation and industrial activities. Long lasting pesticides are common in both agricultural and domestic operations. Synthetic organic compounds enter our environment from a variety of uses, such as solvents in automotive, industrial, electronic and dry cleaning operations--to mention a few.

** ORGANIC WASTE AND LOW DISSOLVED OXYGEN

Organic pollutants consist primarily of decaying plant and animal material and excrement, which consume oxygen as they decompose. If the loading of organic pollutants is too great, the dissolved oxygen essential to most desirable forms of aquatic life may be depleted. The fish and other organisms in the waterway are then driven away or killed.

THE NATURE OF NON-POINT SOURCE POLLUTION

The nature and magnitude of non-point source pollution is difficult to evaluate. It is dispersed over time and space, therefore, data collection is far more costly and complicated than for point sources.

Its effects on the environment are unique because of its

random magnitude and sudden impulse loading of contaminants. Effects of non-point pollutants vary depending on the topography of the watershed, frequency and quantity of rainfall and the system of channels transporting the water. Therefore, identifying regional characteristics for non-point pollution has been difficult.

Data from selected watersheds indicate that the highest concentrations of pollutants--excluding suspended solids--are derived from residential land use, followed by commercial, then rural areas.

While residential land use in Sonoma County is a factor contributing to non-point pollution in the Laguna de Santa Rosa; the consistently high coliform counts, high nutrient levels, and low dissolved oxygen monitored in the laguna indicate that surface runoff from agricultural areas and malfunctioning septic systems are the the real threats to water quality.

SOLUTIONS

Although initial monitoring indicates that agricultural land use is the primary problem affecting the laguna, solutions for both urban and rural problems are included because the laguna is heavily polluted and probably affected by both sources. Also, as Sonoma County becomes more developed and efforts are made to reduce agricultural runoff, urban surface runoff will increasingly affect water quality.

The Association of Bay Area Governments (ABAG) suggests the following low cost solutions:(8)

Improved **street sweeping** will reduce the transport of heavy

metals, nutrients, pesticides, organic and microbiological pollutants.

Controlling the use of certain chemicals, educating the public on the proper use and disposal of hazardous materials and promoting oil recycling would reduce the toxic substances in our water. This would also minimize the exposure of plants and animals to harmful substances.

Cleaning storm drains and channels would remove accumulated sediment and nutrients--such as nitrates and phosphates--along with oil and grease loads. Elimination of litter and leaves would reduce the oxygen demand in the waterway.

The development of anti-littering campaigns and enforcement of dumping prohibitions would keep refuse out of water systems. This will benefit the aquatic dwellers who inadvertently eat debris and enhance recreation potential for humans.

Controlling erosion would include regulating construction and other soil moving activities. Land management for agriculture and grazing should include considerations of surface runoff. This would enhance the laguna by reducing siltation, nutrients, pesticides, plant matter and fecal material from livestock. As a result, there would be less turbidity, less algal blooms and less organic waste which consume dissolved oxygen.

ABAG further recommends buffer strips for riparian corridors and stringent land use policies.

CONCLUSIONS

While the community, press and local environmentalists have

decried the discharge of treated effluent into the Russian River, the California Regional Water Quality Control Board reports "that the discharged wastewater meets...criteria. It is apparent that significant amounts of pollutants are entering this aquatic system from various land uses in the surrounding watershed, [and] the laguna is quite possibly the most polluted segment in this... system.(9)

We must redirect our energy toward controlling non-point source pollution and surface runoff instead of solely targeting wastewater treatment because it's easy to identify. We can begin by implementing ABAG's recommended control measures detailed above.

It is important to note that many pollutants are generated from every day living. The automobile illustrates this clearly. During routine operation we generate lead from the combustion process, particulate matter from our tires and road wear, and many hazardous by-products: used motor oil, transmission and brake fluids, antifreeze etc. These may leak onto roads and parking lots and are then washed into a storm drain and out to the laguna during the next rain. The lack of hazardous waste collection sites and convenient locations for oil recycling encourage illegal dumping--often into storm drains.

Therefore, in absence of government measures individuals can take action to reduce non-point pollution. Some examples are: using public transportation and carpooling; recycling motor oil; conscientious disposal of hazardous materials e.g. batteries, paint thinners, caustic cleaners and pesticides; cleaning up after our pets, monitoring our septic systems, protecting riparian areas from overgrazing and pesticides, not dry cleaning our clothes, and

using non-toxic and biodegradable cleaning products.

The list could go on, but the first step to restoring the laguna is for everyone to realize that non-point pollution is produced in small part by each individual and the sum of our contributions create the largest pollution problem in our watershed.

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*THE ROLE OF THE MEDIA
IN
THE LAGUNA de SANTA ROSA ISSUE*

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ENSP 321
The Biological Environment
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May 18, 1989*

The Role of the Media in the Laguna de Santa Rosa Issue

For quite some time now I have had a dislike for the way the news media, and in particular, newspapers tend to either slant the issues to their point of view or else sensationalize issues with tabloid type headlines in order to attract attention and sell more papers. Classic examples of this can be seen in the past Presidential election, where one candidate was promoted over the other, and in the recent demonstrations surrounding the abortion issue, where one side of the issue is given priority coverage over the opposing view. I believe that to a certain degree our own local media is guilty of some of the same practices.

In this report, I will point out some of the ways in which the local press engages in these practices, and the effects that it has on the local community and the issues in question. I will also discuss how special interest groups as well as individuals capitalize on these practices to promote their own interests.

The purpose of this report is to focus attention on the important role, both negative and positive, that the local press plays in the continuing debate as to the future of the Laguna De Santa Rosa.

Newspaper Articles

My research for this project began by searching out and reading every article that I could find written about the Laguna over the past few years. I began in the University library at the reference desk and found that one of the librarians had a small collection of articles about the Laguna.

Next I went to the main library in Santa Rosa and at the reference desk I was given a folder full of articles labeled "*sewage crisis*". I made copies

of everything I found and began reading.

When I sit down to read a paper, I usually scan the various headlines until I come to something which sounds interesting. Prior to my taking this class almost all of my personal knowledge of the Laguna and the wastewater disposal issue came from scanning headlines. As a result, I have always been under the impression that the sewage treatment plant on Llano Road was releasing water which contained raw sewage. As I began to read through the articles which I collected for my research, I began to see why I had this opinion. In an article dated February 7, 1988, the Press Democrat quoted retired Fisheries Biologist Bob Sharp as saying, "*There's an ingrained repugnance when you say 'sewage' to most people. It comes out as a four-letter word.*"¹ My observation of newspaper headlines has been that they love to use words which are repugnant and inflammatory. Headlines such as: **'Wastewater battle lines drawn'**, (PD 1/29/86), **'Marin next battleground for SR'**, (PD 11/28/88), **'Higher sewer releases OK'd'**, (PD 10/15/86), **'SR may use river for waste after all'**, (PD date unknown) and **'Sewage fight shifts to Laguna de Santa Rosa'**, (PD 2/7/88), all contain repugnant and inflammatory words and phrases which actually imply full scale war between local communities and individual groups. Such words and phrases have a great impact on local opinion and help to stir up more controversy.

Special Interest groups

The press isn't the only guilty party in this 'war' of conflicting views and interests. Special interest groups have become very adept at using the press to convey inflammatory messages by way of candid and outraged comments. Russian River activist Brenda Adelman was quoted as saying, "*I believe they cannot stay in the river without destroying the Laguna and*

3.
killing people along the river".² Even though it was pointed out that "Most environmentalists favor reusing water of that quality", Adelman responded with, " They tell you it's safe, but no one really knows"

Often politicians get involved with these issues, especially when the issues involve their constituents. Take for example a statement made by west county Supervisor Ernie Carpenter in response to Santa Rosa's plan to pipe treated wastewater to the ocean. He said, "*You put that pipeline out there and it's goodbye Sonoma County,.... You're talking the Santa Clara Valley, ..mountain to mountain, north to south, filled up with houses and industry.*"³

The press liked this statement so much that they included it as part of the headline for the article. Statements such as this pose a false dilemma which implies that solving the wastewater disposal issue will ultimately result in the paving over of Sonoma County.

The Laguna has become a pawn in a much larger chess game called 'selfish special interest'. It has been used by the no-growth proponents as a smoke screen to disguise the fact that they want to see growth in Sonoma County stopped.

In preparation for this report, I spent some time talking with Scott Stinebaugh, waste water superintendent at the Llano treatment plant. One of the topics which I brought up was that the press always seemed to be trying to stir up controversy surrounding the issue. Mr. Stinebaugh felt that it wasn't as much the fault of the press, as it was the fault of some environmentalists groups along the river who were using the press to promote their own special interests. He said that the real issue was growth. Since Sonoma County doesn't have a water shortage problem, which is a major deterrent to growth, no-growth proponents have attacked the disposal issue.

My question is: why doesn't anyone seem to be concerned about

non-point source pollution, which has been proven to be far more hazardous than the water being discharged through the Laguna by the city? If the press wants to be objective, it would seem that an article addressing the subject of non-source point pollution would be an excellent way of promoting public awareness to the problem. Such an article could also serve to provide information as to water quality comparisons between treated wastewater and untreated runoff. It might even help to clear the air of some of the 'smoke' which has been blowing around and clouding up the issue.

There was a certain prestigious club which was accepting some new members. One of the new candidates beamed broadly when her name was brought up for a vote. After being voted in by a narrow margin, she promptly raised her hand and made a motion that the nominations be closed. I think this illustrates what happens when some special interest groups get what they want and then fight to keep everyone else from having any. When a so-called environmentalist starts putting his or her selfish interest ahead of what is really good for the environment, they no longer deserve the title. On the other hand, when environmentalists are unselfishly united over an issue, their voice is heard and much is accomplished. We can see this unity in the off shore drilling debate and the impact which it has had.

The Real Issue

Since the press is constantly writing about the issues of the day, it is impossible to write about the impact of the press on the Laguna without also dealing with the issues. When you strip away all of the hype and rhetoric, the real issue is whether or not treated wastewater from the Llano treatment plant is clean enough to use as a year around water supply to maintain the Laguna as a natural wetland, and ultimately be released into the Russian River. It would seem likely that this question could be quickly

resolved by the state's Water Resources Control Board. However we see in a Press Democrat article that, "*The State Water Resources Control Board Tuesday narrowly approved relaxed standards for Santa Rosa's discharge for treated sewage into the Russian River...*"⁴, and a headline which says "**3-2 vote changes river discharge rules.**"⁵ Further into the article one can see where the River Citizens Sewer Committee along with Supervisor Ernie Carpenter attack the new rules as "*a ruse to encourage continued runaway growth in Santa Rosa.*"⁶ The point being that supposed impartial government agencies are somewhat manipulated by special interest.

Divided Interest

In addition to the River Citizens Sewer Committee and their political supporters, there is the Bodega Bay Area Chamber of Commerce, the University of California's Bodega Marine Lab, and an ad hoc committee formed to oppose ocean discharge, as well as any other group who is opposed to further growth in Sonoma County. Each one of these organizations list their own reasons for opposing the discharge of treated wastewater regardless of how many plans are submitted for a possible resolution of the problem.

One of my biggest points of contention with the environmental community is that they are often quick to oppose the solution to a problem, but are very slow in proposing any alternate solutions. Instead, different groups successfully 'box' in the the problem, and then spend all of their energies fighting amongst themselves while the problem, (in this case the Laguna) goes unsolved. Finally, some government agency steps in and solves it to no one's satisfaction.

I recently attended a public hearing at the Santa Rosa City Hall which was organized by the League of Women Voters and designed to address the

issue of turning the Laguna de Santa Rosa into a National Wildlife Reserve. Each of the panelists were asked to speak briefly about the plan and give their input as public officials and professional members of the community.

Several of the panelists expressed support for the plan and gave supporting facts and figures. One panelist took a very cautious approach and raised some very legitimate questions regarding the future of farming along the Laguna. The last panelist to speak was a spokeswoman for the River Citizens Sewer Committee. She simply stated that they were opposed to any such plan, and that it was nothing more than a ruse to dump more of Santa Rosa's treated sewer water down the Russian River. What was most interesting to me was that it turned out that she is also the president of the local chapter of the Sierra Club, an organization which is in favor of the National Wildlife Reserve Plan. This is about the best example that I can give for a 'house divided against itself'. I think this example typifies the division which exists between special interest environmental groups when the issues in question conflict with their own personal interests. The press, meanwhile is quick to pick up on conflicts such as this and run headlines that read, **"ENVIRONMENTALISTS AT ODDS: Sewage fight shifts to Laguna de Santa Rosa"** (PD 2/7/88).

Summary and Conclusions

I chose to write about this topic because I feel that the news media, and in this case the press, has a strong tendency to sensationalize issues such as the Laguna and the question of treated wastewater. In so doing, they not only stir up more controversy surrounding the issue, they become willing participants in the battle between special interest groups and local communities.

My purpose for this report was to show the important role that the

press plays when dealing with community issues which effect us all.

During the course of my research, I discovered that it is not uncommon for the press to use repugnant and inflammatory statements as well as headlines which suggest all-out war between groups and communities, to promote more interesting reading.

The press, however, isn't the only guilty party in this controversy. Special interest groups, calling themselves environmentalists, use the press to promote their own selfish interest by means of candid and outraged statements made by key leaders who possess a high level of public visibility due to their professional positions, or public offices.

Those opposed to using the Laguna for the purpose of discharging treated wastewater, use water pollution as their main argument. However, it seems that the real issue is growth in Sonoma County. They are probably able to rally more public support around a pollution issue which is non-economic, than a growth issue which is. The biggest hole in their pollution argument is that the water being discharged by the city is much cleaner and far less toxic than the water that goes into the Russian River via natural run off. No one seems to be addressing the problem of non-point source pollution. I feel that the press could do a great service for the community by running a series of articles dealing with non-point source pollution and the possible impact it can have on drinking water.

When debating whether or not treated wastewater is clean enough to be released into the Russian River, it would seem like the question could be easily resolved by the state's Water Resources Control Board. However we see that even a supposed impartial government agency can be influenced by special interest issues.

Finally, it becomes evident that the real stumbling block to any solution to the Laguna issue is selfishness. As long as people and groups

continue to fight over trivialities, our victim, the Laguna, will continue to grow weaker and eventually die, unless someone forces the issue and brings about a speedy recovery.

I do not think that it would be entirely fair to dwell only on the negative aspects of the press' role in dealing with the Laguna issue. The press has been faithful in writing many articles on the subject. For those who have found the issue interesting enough to read more than just the headlines, the press has been a source of information that otherwise would not be available. Television coverage could not begin to address all of the complex issues surrounding the laguna.

I believe in freedom of the press, but I also believe that along with freedom comes responsibility. Often, the survival or defeat of a worthy cause rest upon the power of the pen.

In conclusion, I believe that it would be safe to assume that the press is not going to change their way of reporting the news. Ever since the early sixties they have done pretty much what they please without any regard for the innocent people or worthy causes that may be effected or destroyed.

The only alternative which remains is for the environmental community to put aside their petty differences and pull together on issues as important as the laguna and wastewater disposal. I also believe that it is time for the real environmentalists of our community to come forward and expose those special interest groups who hide behind the title in order to promote their own selfish interest. Unfortunately, it doesn't often happen that way and positive progress doesn't result until *everyone is equally dissatisfied*

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**Laguna De Santa Rosa
An Educational Unit**

by Patricia Brunelle

Introduction

My interest in the Laguna De Santa Rosa began with my studies in Jeanne Merriman's Biological Environment class, Spring of 1989. As we went on the field trips to the Laguna and followed up with lectures, I began to realize the importance of site assessment. Site assessment is designing a curriculum in relation to a specific site. It is integrating actual experience with learning about a place and its attributes. The Laguna is a laboratory for observation and experimentation; a library of data about geology, ecology, history, flora and fauna; a source of inspiration and renewal; and can be a testing ground for its inhabitants. By integrating site assessment we begin a reciprocity between thinking and doing and the knowledge gained loses much of its abstractness. Things learned become applicable to specific places and problems are related to the tangible and direct. Places are important to learn about, they are laboratories of diversity and complexity that mix social functions and natural processes. Today more than ever, we need to develop a sense of place, a sensitivity to special environments, to preserve them and manage them to best of our abilities. The Laguna De Santa Rosa is such a place. Gary Snyder puts it together well from this quote.

" No amount of well-meaning environmental legislation will halt the biological holocaust without people who live where they are and work with their neighbors, taking responsibility for their place, and seeing to it: to be inhabitants, and not to retreat."

Gary Snyder

The focus of this paper is to construct a lesson unit incorporating the Laguna and ecology facts that taught at a fifth grade level. As stated earlier, I believe that childrens interest levels can be heightened by tying a real site together with a learning experience. The learning is enhanced with the reality of such a place rather than just words and ditto sheets of work.

Lesson Unit
My Trip Through a Wetland
Laguna De Santa Rosa
A Magazine

Unit Goals - The main goal of the unit is for students to learn the basic components of the Laguna through studying the ecology of wetlands; what is a wetland, why are they important to wildlife and humans, how have we polluted them, and what are there ecosystems like. All of this should be directly related to our Laguna as the the example of a wetland.

I have tried to incorporate all modes of learning; science, art, reading, writing and math skills, along with as much creative experiences as possible. In order to combine all these efforts I have used developing a magazine as the basic format. By doing so the students will be encouraged to develop their imagination, art-istry, writing skills and research skills. This is to be an on - going activity during a six week period on ecology. This unit can be lengthened or shortened to the teachers discretion.

Objectives: By constructing a magazine the students will :

1. Construct a magazine that will include the following.
 - A. Cover
 - B. Title Page
 - C. Dedication
 - E. Foreward
 - F. Table of Contents
 - G. Magazine body, including required and optional work
2. Research one type of habitat, riparian (land) or water. See appendix 1a for related activities, Wetland Metaphors and Alice in Waterland.

3. Identify people through news media, current events and other means who have made contributions to conserving aquatic environments. To include one interview. See appendix 2a for Living Research: Aquatic Heroes and heroines. How exciting for your class if you could get Doug Bosco to be interviewed and talk about his plans for the wildlife refuge at the Laguna!! There is a long list of names of people involved on the Technical Advisory Committee's report who could be easily contacted. Bill Cox of the Department of Fish and Game could offer some great insights into the laguna.

4. Research at least three animals, plants or insects that live in the habitat that was chosen to be described. See appendix 3a for activities related to requirements.

5. Decorate the magazine through different art forms. See appendix 4a for art projects.

6. Write one Trees are Terific article pertaining to some aspect of the trees of the Laguna. See appendix 5a for tree activities.

7. Enter one poem on any aspect of the Laguna. See appendix 6a for activities.

8. Write one article on either Pollution or an Endangered species(see appendix VI for list) and appendix 7a for activities.

9. Complete all required work as listed 1 - 8 and any optional work as desired.

10. Optional Work

1. Glossary
2. Travelogues- Following the Water Cycle. See appendix 8a for activity.
3. A fiction story, see appendix 9a for details.
4. Write a song or create a recipe. See appendix 10a
5. Fun Sections
 - Advertisements - See Survey and Slogans 7a
 - Cartoons
 - Crosswords
 - letters to the editor

11. Anything the students can come up with to include.

Evaluation:

Pre - lesson evaluation will be an informal discussion on what wetlands are and how to construct a magazine. This may include brainstorming and the teacher writing components on the board. The appendix numbers IV - VIII list all plants and animals of the Laguna and is at the very back of the report.

Post lesson evaluation consists of the magazine and its contents on wetlands and the Laguna De Santa Rosa. Points can be given as follows or changed to your discretion.

The minimum required work 1 - 8 ---- 225 points

Each additional habitat report---- 25 points

Each additional fiction story----20 points

Each additional travelogue---- 20 points

Each additional art work -----10 points

Each additional poem ----10 points

Unique contributions----additional points as merited

A ---- 300 pts

B ---- 210 pts

c ---- 125 pts

Strategies - The lesson should begin by students bringing in magazines to examine the contents , then hold a discussion on how they are constructed. Use magazines dealing with natural elements; Ranger Rick, Outdoor california, Audubon, National Geographic, and similar ones to these.

The second phase should revolve around wetlands. For further information see appendix A, What makes a wetland a wetland? The teacher should introduce different aspects of a wetland to the students through discussion and sharing of basic knowledge.

The third phase should integrate what the Laguna De Santa Rosa is and where it is located. A field trip should be organized at this time. See Exploring A Wetland for field trip tips, appendix 4a. The Llano Treatment Plant may have access points in the future to mitigation and irrigation sites. They are receptive to open access and are working toward that goal.*

If a field trip is impossible you may want to contact the Department of Fish and Game for a possible slide show of the Laguna. Films that are free and low cost are available from Cooperative Extension University of California(Wildlife Extension 916- 752-1496). This is the most important part of the unit as you be introducing the Laguna as a wetland to develop site assessment. Maps are available from the Sonoma County Water Agency and the Planning Department.

The remaining information about wetlands will be developed while producing the magazine, each activity delves into a specific area of wetlands as they may pertain to the Laguna De Santa Rosa. The activity on The Laguna: How it Used to Be, will be a valuable tool to discover the history and insight of what it was at one time. See Appendix B. This could be used as an introductory element for the history or geology of the area.

In the following pages is an introduction to some basic facts about the Laguna to aide in your presentations, activites and discussions on the Laguna De Santa Rosa as a wetland. More information is available in Report of the Laguna Technical Advisory Committee, Jan. 1989, on reserve at the main library.

The Laguna - The Laguna is a fourteen mile water way from Cotati to the Russian River surrounded by Santa Rosa, Sebastopol, Rhonert Park and Cotati. Depending on the time of year it is a

series of lakes, streams, and marshes that empties via Mark West Creek into the lower Russian River. The marshes were at one time much more extensive than they are now. In the old days the overall water capacity was much larger. There used to be natural lakes and ponds which for the most part have disappeared. The marsh vegetation, willow and alder thickets were much more extensive than the small remnants we see today. Several years ago, Sonoma County put a channel through the lower part of the marshlands and open water areas. This channelization further reduced the refuge. The Laguna still represents one of the largest fresh water-marsh areas in the Coast Ranges, Clear Lake being the largest in the state.

The Laguna De Santa Rosa is unique from the marshlands of Clear lake in that the Laguna is more diverse. The Laguna presents a wide range of ecological situations. The Laguna is a complex system of wetland and upland habitats, open water, emergent marshes, riparian forest, (oak being the dominant tree) , vernal pools, oak savanna, oak woodland and grassland. These habitats provide living space for 230 birds, 286 plants, 25 mammals, 19 fishes, 7 amphibians and 9 reptiles (all listed in appendix IV - VIII). The water is a stopping point for migratory birds in the Pacific Flyway. Amongst all of this is included five rare plants (endangered) and four endangered animals. The bald eagle and the yellow - billed cuckoo being two of them. This great diversity is not commonly encountered in a single marshland, which adds to the importance of the Laguna as a unique living museum. Any component of the Laguna can be used in developing the magazine and should be studied as a part of the whole system.

Main concerns for the Laguna center on urban growth and pollution problems. The people factor activity (appendix 7a) can be

incorporated to discuss how humans change the environment through encroachment upon wetlands. Urban growth outside the Laguna affects the water quality, runoff, pollution sources and overall stress on the Laguna.

Sources of non-point pollution have a direct impact on the Laguna. These pollutants are fertilizers, pesticides, poorly maintained septic tanks, spraying of effluent and cows. The fertilizers and manure have a direct effect on the nitrates in the water of the Laguna. The fertilizers add to the nitrogen and phosphorus limits in the water. These raised limits can cause algae blooms in the water reducing the amount of dissolved oxygen and air for fish life, causing extensive fish kills. All of these pollutants start from a land base and run off uncontrolled into these waters. The two major areas of concern for pollution are storm water and agricultural chemical which are direct causes of damage done to the Laguna.

When discussing the water cycle of the Laguna it is important to note the many ways humans have caused changes in the hydrological cycle. The cycle itself is a biogeochemical cycle that moves and recycles water(related activities in appendix 8a), in various forms through the biosphere. There is less water moving in the Laguna because of channelization and loss of riparian forest. This directly effects the amount of transpiration and evapotranspiration that is happening in the Laguna. Water infiltration is low in the Laguna because of the clay like soil. By moving water faster through the Laguna less time is allowed to certain areas that do infiltrate, which in turn causes less available groundwater. The reduction in vegetation also has an adverse effect on erosion during rainfall. Less vegetation also leaves less water held in the soil as a resource for plants and animals. This in turn impacts the cooling

effect on the land and water.

The more we clear land for agriculture, construction and roads, the larger the increase for erosion and reduction of seepage. All of this increases the risk of flooding and puts pressure on needed basin are in the Laguna.

Conclusion

From all of this information I would hope the reader will conclude the Laguna is a diverse and important laboratory, one that is vital to our educational needs. This packet of educational material takes the learner into a personal experience with wetlands via the Laguna De Santa Rosa. Hopefully through developing the magazine the students have become more aware of the importance of wetlands, especially the one in our backyard, Laguna De Santa Rosa.

Different activities throughout the packet offer hands on experiences and the interrelationship of humans and wetlands. This gives the student a vehicle of action which they can use in the the everyday world relating to people and our environment.

References

- (1)* Judy Nosecchi, Supervisor Llano Treatment Plant, Personal communication, May 1989.
- (2) Demars, John and others. Laguna De Santa Rosa Environmental Analysis and Management Plan, May 1977.
- (3) Laguna Advisory Committee Report to the City of Sebastopol, January 1988.
- (4) Western Association of Fish and Wildlife Agencies and Western Regional Environmental Education Council, Aquatic Project Wild, 1987.

ACTIVITIES

Wetland Metaphors	Dragonfly Pond
Alice in Waterland	Deadly Waters
Living Research	Where Does Water Go
Are You Me	After School
Aquatic Roots	Something is Fishy Here

- (5) National Wildlife Federation, Nature Scope, Endangered Species: Wild and Rare, 1988.

ACTIVITIES

Rare Scare
People Factor

- (6) National Wildlife Federation, Nature Scope, Wading Into Wetlands, 1986.

ACTIVITIES

What Makes A Wetland A Wetland
Little Green Monsters
Crafty Corner
Explore A Wetland
Surveys and Slogans
Recipes

- (7) National Wildlife Federation, Nature Scope, Trees are Terrific, 1988.

ACTIVITIES

Celebrate Trees
Learning From "The Lorax"
Picture Poetry

- (8) Dan Whittemore, Song Book "Tripping with Terwilliger", The Terwilliger Nature Education Foundation, 1976.

ACTIVITIES

Songs A Home Somewhere
Outside Happy and Free

- (9) Instructor Magazine, April 1989 issues, Published by Edgell Communications Inc.
- (10) Educational Insights, Discovering Nature: 135 Nature Study Insights, Educational Insights.
- (11) Hidden Villa Environmental Education Program, Manure, Meadows, and Milkshakes.



WHAT MAKES A WETLAND A WETLAND?



The water's up to your ankles and a pungent smell reaches your nose. You move along slowly, watching a great blue heron fish for its lunch. When you round a bend, you're startled by a flock of ducks as they take off from the water. A dragonfly zips past your head as you watch the ducks fly up over the trees.

You could be in a swamp. Or a salt marsh. Or any of a number of different types of wetlands. In this chapter we'll discuss just what we mean by the word *wetland*—and we'll look at what makes these soggy habitats so special.

WATERLOGGED WORLDS

It's hard to find a lot of absolute characteristics that apply to all wetlands. That's because there are so many different kinds of bogs, marshes, swamps, and other wetlands. (For descriptions of many of the different kinds of wetlands, see the background information on pages 18-20 and 33-35.) But all wetlands share some characteristics that set them apart from other kinds of habitats.

What They Are and What They Aren't: Of course, all wetlands are wet—but so are ponds, lakes, streams, rivers, and oceans. Does that mean, then, that these particular bodies of water are wetlands too?

In general, no. Most scientists who study wetlands restrict their definition of these habitats to areas that, at least periodically, have waterlogged soils or are covered with a relatively shallow layer of water. These areas support plants and animals that are adapted to living in a watery environment. (For more about the plants and animals that live in different kinds of wetlands, see Chapters 2 and 3.)

Soggy Surroundings: The reason that wetlands are wet varies. Since most wetlands are located in low-lying areas, rain and runoff help to keep them saturated. Also, some wetlands lie in places where the groundwater is at or very near the surface of the ground, which means that they're constantly being "fed" from below. Other wetlands stay wet because they're next to rivers or other bodies of water that regularly overflow their boundaries. And along the coast, the tides keep many other wetlands saturated.

Beavers and Other Builders: Some wetlands get started with a little "outside" help. Beavers, for example, are important wetland builders. The rivers and streams that they dam often flood large areas, turning meadows into marshes or parts of forests into swampland.

People sometimes create wetlands too—both intentionally and unintentionally. For example, a state game and fish agency might flood an area so that waterfowl will have more places to breed. On the other hand, a swamp or marsh might get its start accidentally when construction blocks the natural flow of water and causes a stream to back up and overflow.

WETLANDS AT WORK

Wetlands give the world a lot of "free services." Here's a look at some of the important functions they perform.

Flood Busters: An easy and cheap way of controlling floods is to leave wetlands in their natural state. That's because wetlands act like giant, shallow bowls. Water flowing into these "bowls" naturally loses velocity as it collects and spreads out.

(continued next page)

The Laguna: How it used To Be

This is a fun activity to engage thoughts of the history or geology of the Laguna. The story could be changed to highlight whatever area was necessary. Do this by having the children relax, eyes closed and read them the following story of how the Laguna might have looked a long time ago to present. See procedure on the next page, Creative Visualization, for preparing the students before reading the story. After the reading have the students draw a picture or write a poem or short story for the magazine on what they visualized the Laguna to be like thousands of years ago.

READ

Now that we are nice and relaxed, we are going to travel back in time thousands and thousands of years ago to see what our Laguna used to be like. Imagine yourself looking down on a big valley of rocky soil and clay formed from an erupting volcano. The plants and animals are all very small. See the mountains to the west of the valley being pushed up and pushed up by the colliding North American and Pacific Plates. As the mountains are pushed up the Sonoma Valley begins to form its shape.

Visualize the running water from rain storms and melted snow caps rushing down these mountain forming streams and creeks throughout the valley. All these creeks meet at one big flat spot almost in the middle of the valley and form the widespread Laguna. In the summertime the sun is warm and the lakes of the Laguna are full and surrounded by beautiful oak, willow and alder trees. The banks of the lakes are high and crowded with plants, trees and shrubs along its shore so thick you cannot see through them. The egrets and Blue herons happily dance along the shores feeding on rising fish and plants.

Lesson Plan

Age Group: Fifth Grade, but can be adapted to any grade level

Subject: The Laguna: How it Used to Be (history and geology)

Objectives: Creative Visualization is used to introduce the class to the Laguna and its previous history.
Follow the procedure by setting tone, then reading the relaxation exercise(next page) followed by reading the Laguna story.
It is the purpose of this format to encourage imagination, artistry, writing skills and listening skills.

Materials: Plane tickets (3 x 5 cards), pencils, crayons and drawing paper.

Procedure: I have condensed the procedure and included a copy of an example relaxation exercise from Picture This: A manual for teaching reading thru visualization and literature by Laura Rose, 1984, printed by Humbolt County of Education.

The common process of the visualization should go as follows:

- 1). Set tone 2). Distribute materials 3). Blindfold: Dim lights
 - 4). Relax 5). Visualize 6). Ground 7). Share
- 1). **Tone** - Tell the students the reason for learning to visualize better is based on new information about the brain and how it learns best . Learning to create pictures in their minds will help them to enjoy reading more when they can make their own pictures as they read. Reading will open up a whole new world to experience.
 - 2). **Distribute materials** - Distribute materials so grounding work can be done immediately. Let students know they will be expected to draw or write at the end.
 - 3). **Dim lights** - Dim the lights just as you are ready to begin.
 - 4). **Relaxing** - Helps the students shake off busy thoughts and tune into your voice. Some studies show that relaxing before learning something new or being tested, they learn, retain, and perform better. Also reduces stress levels.
 - 5). **Visualize** - Students usually find some way of creating images. If problems occur, tell them that you know they will find a way to see soon. Visualizing is like using a muscle, the more you use it the stronger it will get. They can always pretend to see.
 - 6). **Ground** - At the end of the visualization remind students that there will be no talking until drawings or writings are done. The grounding is the essential link between the right and left brain, between imagery and symbol. It is a physical representation of the image seen in the mind. This can be accomplished by drawing, painting (crayons are best), sculpturing and singing as a few possibilities. The drawing should be a quick sketch of the essence of their experience.
 - 7). **Sharing** - Oral sharing of the experience. Sharing gives the opportunity to further ground images by use of words. Sharing should be voluntary. Give a chance to share or not to share.

WETLAND METAPHORS



Objectives

Students will be able to: 1) describe the characteristics of wetlands; and 2) demonstrate their understanding of the importance of wetlands to wildlife and humans.

Method

Students are presented with a selection of "hands-on" objects for investigation as metaphors for natural functions of wetlands.

Background

Wetlands are many different things to many different people. Some people have never heard or thought about wetlands. Others are working actively to protect wetlands because of their importance.

Wetlands include areas like freshwater and salt-water marshes, wet meadows, swamps, lagoons, bogs, and prairie potholes. All wetlands, whether coastal or inland, provide special habitats that serve areas far beyond their boundaries. Wetlands are uniquely important to plants, animals, humans, and the total environment.

Because of the abundance of food, vegetative cover (shelter), and water found there, most wetlands are rich with diverse wildlife species.

Coastal and inland marshes, for example, provide breeding, resting and wintering habitats for thousands of migratory birds—including ducks, geese, swans, cranes, and shore birds. Many species of fish that are important for commercial and personal use by humans reproduce and spend part, or all, of their life cycle in fertile wetlands adjacent to larger, more open bodies of water. These fish species include bass, salmon, walleye, perch, and pickerel. A wide variety of reptiles, amphibians, insects, and crustaceans also breed and live in wetlands. Frogs and toads, turtles of all kinds, salamanders, snakes, dragon-

Age: Grades 1–12

Subjects: Science, Language Arts

Skills: analysis, application, classification, comparing similarities and differences, description, generalization, identification, inference, interpretation, listing, public speaking, recognition, reporting, small group work, synthesis, visualization

Duration: one or two 30-60 minute periods

Group Size: any

Setting: indoors or outdoors

Conceptual Framework Reference: III.A., III.A.1., III.B., III.B.1., III.B.2., III.B.3., III.B.4., III.C., III.C.1., III.D., III.D.1., III.D.2., III.D.3., III.D.4., II.A., II.B., II.B.1., II.B.2., II.B.3., II.C., II.D., II.E., II.F., I.A., I.A.1., I.A.2., I.A.3., I.A.4., I.C., I.B.1., I.B.2., I.B.3., I.B.4., I.C., I.C.1., I.C.2., I.C.3., I.C.4., I.D.

Key Vocabulary: wetlands, metaphor

Wetland habitats are being converted to other uses (agriculture, roadways, housing developments) or otherwise being destroyed (drained for pest control or polluted) at the rate of a half million acres per year. And although many wetlands are protected by federal and state laws, there still appears to be a significant need to create a greater understanding of the importance of wetlands as ecosystems and as wildlife habitat.

The major purpose of this activity is for students to develop an appreciation and understanding of wetlands through the power of metaphor, linking the characteristics and natural functions of wetlands to the familiar realm of everyday life.

Materials

a large pillowcase, bag, or box; sponge; small pillow; soap; eggbeater or mixer; small doll cradle; sieve or strainer; paper (coffee) filter; antacid tablets; small box of cereal; 3 x 5 cards with pictures that could be used to show other wetland metaphors (a zoo could represent the idea of wildlife diversity in a wetland, a lush vegetable garden could represent the idea of a productive wetland in which food is abundant, a vacation resort could represent the idea of a resting or wintering place for migrating waterfowl)

NOTE: A metaphoric approach such as this allows a variety of objects to suggest some appropriate linkage to the basic characteristics of wetlands.

Procedure

1. Prepare a "Mystery Metaphor Container" (pillowcase, bag or box). It should be possible for a student to put his or her hand into the container and pull out an object. You may want to collect as many as one metaphoric object per student, but at least have enough for one per group of four students. Put the container aside to use later.

2. Discuss the variety of wetlands found in your local area, state, country, etc. Then invite the students to sit quietly and close their eyes. Ask them to imagine and visualize a wetland. Have them examine what it looks like. Have them look carefully at the plants and animals, including insects and small creatures. What does the air feel like? How does it smell?

OPTIONAL: Play a tape recording of natural sounds from wetlands. Some are available commercially in record and nature stores.

3. Invite the students to tell what they imagined. Compile a list of their offerings. Encourage discussion and mutual sharing.

4. With their list as a point of reference, help the students identify which plants and animals are actually most likely to be found in a wetland. If possible, have them classify the plants and animals according to the kind of wetland in which they would be found. State or federal wildlife officials and representatives of private conservation or nature-related organizations can be helpful. The series of Golden nature guides from Western Publishing Company, Inc. are also useful. "Wading into Wetlands" from the National Wildlife Federation's *Naturescope* series includes a variety of useful information as well.



5. Next provide the students with background information to serve as an overview of the basic ecological activities that characterize the wetland habitat. For example, you can include the following:

- Sponge effect - absorbs runoff
- Filter effect - takes out silt, toxins, wastes, etc.
- Nutrient control - absorbs nutrients from fertilizers and other sources that may cause contamination downstream
- Natural nursery - provides protection and nourishment for newborn wildlife
- etc.

Suggest that these activities and many more that they could probably think of are taking place in wetlands all the time.

ALICE IN WATERLAND

Objectives

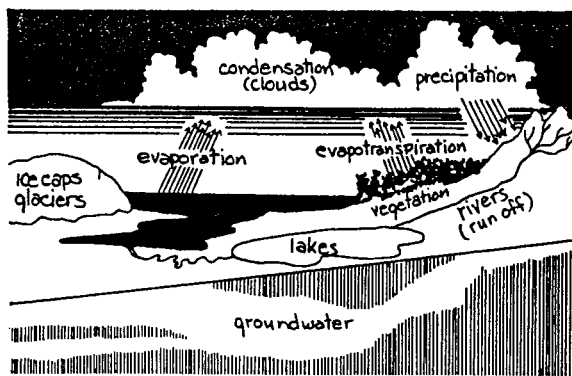
Students will be able to: 1) trace their domestic water to its source prior to human use and to its destination after use; 2) identify potential effects from human water use on terrestrial and aquatic wildlife; and 3) develop and practice responsible water conservation behaviors.

Method

Using guided imagery, lecture-discussion and student-gathered data, water use and its effects on wildlife habitat will be explored.

Background

Water use is such an automatic and habitual daily activity that students often do not understand the consequences of its use. Seldom do they connect the water that comes out of the faucet to its sources in the natural world.



A model that traces the dynamics of water is called the water cycle or the hydrologic cycle. The water cycle involves the path of water from when it falls in the form of rain or other precipitation on a watershed; to its travel as runoff that flows into streams, groundwater systems, lakes, reservoirs, estuaries, and oceans; to its eventual return to the atmosphere through evaporation and evapotranspiration; to its formation into clouds; to its condensation in the form of precipitation as it again falls on a watershed in this continuing process. The great storehouses of water—glaciers and icecaps—are also part of this cycle. All forms of life on earth are dependent upon and affected by this cyclical journey of water.

Age: Grades 5—12

Subjects: Science, Math

Skills: analysis, application, computation, description, discussion, drawing, estimating, evaluation, generalization, identification, inference, interpretation, invention, listening, listing, mapping, media construction, observation, problem solving, synthesis, using time and space, visualization

Duration: two or three 45-minute periods

Group Size: any

Setting: indoors or outdoors

Conceptual Framework Reference: VII.A., VII.A.1., VII.A.2., VII.A.3., VII.A.4., VII.B., VII.B.1., VII.B.2., VII.B.3., VII.B.4., VII.B.5., VII.B.6., VII.B.7., VI.A., VI.A.2., VI.A.3., VI.A.4., VI.A.5., VI.B., VI.C., VI.D., IV.A., IV.B., IV.C., IV.D., IV.E., IV.F., I.D.

Key Vocabulary: water cycle, hydrologic cycle, conservation

"Imagine that you are small enough to climb into the faucet in your kitchen. . . . Pretend you have magic powers that allow you to travel through the water that comes from the faucet to its origins. . . . You will be able to pass through all the pipes, valves, and other barriers on the way. . . . The first part of the journey takes you through the pipes in your house to where it connects to your water source. . . . If you live on a farm or ranch the source would probably be a well or perhaps a spring. In the city, the water source for your home probably would be far away. . . . First you get into a water main. . . . Then you come to a pumping plant where water pressure is maintained. . . . Past the pumping plant is a place where the water is purified. . . . This may be very complex—a place with filters, chemical tanks, and treatment equipment. . . . Beyond the purification plant, the water may be in an aqueduct or open channels coming from a reser-

voir. . . . The reservoir is a huge lake where water is stored. . . . There are often trees and bushes on its edges. . . . Wildlife is common, fish are usually abundant, and people often use the site for recreation. . . . Natural streams usually flow into the reservoir. . . . They drain large areas of the land's surface which are called watersheds. . . . A watershed is the land area that catches and transports water through streams, underground flow, and rivers. . . . The water in a watershed contains all the water that is naturally available for use by all living things in that area. . . . If you want, stay in the watershed. Try to see the plants and animals that live in the area. Or, follow your route all the way back through the reservoir and channels and treatment plant and pumping plant to the water main and the pipes in from your house and out your faucet. Then, open your eyes."

2. After this imagery, discuss the journey of the water from its source to the faucet. Identify the components of the journey. Emphasize the places where wildlife habitats are affected—positively, negatively, or with unknown effects—by the intervention of people as they use the water or influence how the water is to be used.

3. Have the students create a mural on a single long sheet of butcher paper, depicting the origins and journey of water from their home to its source. Have them emphasize wildlife and habitat all along the way.

4. Repeat the imagery process for a journey down the drain into the wastewater system:



"Imagine you are small again. This time the journey will be down the drain in your sink. You move along through the used water system to a treatment site. . . . If you live on a farm, the site probably will be a septic tank. . . . A septic tank is usually a large concrete box. . . . Here bacteria break down the substances carried in the water. . . . Once the water is cleansed to the degree possible, it flows out through drainage fields and back into groundwater sources or streams. . . . If you live in a city, there is much more water being used and large water treatment plants must attempt to cleanse the water before it is returned to rivers and streams. . . . In these treatment plants there are great filters and holding tanks. . . . The water must be held in

place for solid substances to settle out by gravity. . . . Air is often pumped through the waste water to increase the oxygen content so bacteria can break down the impurities more quickly. . . . Eventually the treated water is released into rivers and streams. . . . It again re-enters the natural habitat for wildlife. . . . There it provides an essential component for continued life. . . . If all was done well, animals, plants, and humans will safely re-use the water. . . . It will nourish the crayfish caught by the raccoon. . . . It will provide the pond for the box turtle. . . . It will provide the refreshing drink for someone like yourself in some downstream city. . . . After you have followed the water out into the environment, open your eyes."

LIVING RESEARCH: AQUATIC HEROES AND HEROINES

Objectives

Students will be able to describe the importance of the accomplishments of local people who have contributed to conserving or preserving aquatic environments.

Method

Students identify people—through news media, current events or other means—who have made contributions to conserving or preserving aquatic environments; research their contributions, including by interviewing them; and write a biography.

Background

Students are frequently called upon to write research reports about people who are world famous or who have attracted a lot of attention in major media. This can give students the impression that these sorts of active, committed people are always far away from them and that there is no one of accomplishment in their own communities. Yet, all around us, there are people who work tirelessly, year after year, to contribute to the quality of life in their communities. Some of these people focus on issues involving wildlife and the natural environment. Some of these people are employed by state or local governments. Some are in business and industry. Others work through conservation and

wildlife organizations. Many are simply interested and dedicated private citizens, volunteering their time to work on issues of concern. These people may not be famous. They may not have attracted the attention of the media. Often, in fact, they may shy away from such attention. This activity calls upon students to develop their knowledge and appreciation of the efforts of these often unrecognized contributors to their own communities, celebrating the exercise of responsible environmental citizenship. The students will develop an increased understanding of some of the character attributes required of an effective environmental citizen leader; and reinforce within themselves the idea that they too are capable of making a difference on behalf of wildlife and the environment. Efficacy is a word used in political science when talking about whether or not people think they

Age: Grades 7–12

Subjects: Social Studies, Language Arts

Skills: communication, description, interpretation, interview, listening, public speaking, reading, reporting, research, small group work, synthesis, writing

Duration: several class periods of 30-60 minutes each

Group Size: groups of three or four students each

Setting: indoors and in the community conducting interviews

Conceptual Framework Reference: VII.A., VII.A.1., VII.A.2., VII.A.3., VII.A.4., VII.B., VII.B.1., VII.B.2., VII.B.3., VII.B.4., VII.B.5., VII.B.6., VII.B.7., V.A.5., V.B., V.B.1., I.D.

Key Vocabulary: efficacy, citizenship, heroes, heroines

offices, the telephone book, local newspapers and magazines, reporters or editors on the staff of local papers, local television news directors, the presidents or executive members of local groups or clubs. The class might even place an advertisement in the paper, or enlist the aid of a reporter to write up a story on the class project.

3. Once a list of names has been compiled, students in groups of three or four should draw a name at random from the list. Each group will now become a biographical research team to prepare a biography or living history of the person. In some cases the suggested name may be that of a person who was important in the community as a conservationist, but who is now deceased. In these cases, the team will have to identify relatives, friends, former employers, and other potential sources of second hand information to interview.

4. Each team should develop a research plan. This should include the outline of any interviews they may want to conduct, whether with the person directly, or with others who know or knew them. Each team's plan should be discussed with the class and suggestions for improvement considered. After the plans have been discussed and refined, the teams should make contact with the people they want to meet and interview. This should be done using a letter, stating the purposes of their research and suggesting that they will follow the letter with a personal contact by telephone.

5. Once the teams have confirmed the willingness of the people to be interviewed, they should meet with them and conduct the interviews. The basic format for the interview should include any personal history details of note but the major questions to be addressed might include:

- How did you become interested in the aquatic environment?
- What prompted you to take action?
- How did you decide on the course of the action you took?
- What difficulties did you encounter and how did you overcome them?
- What do you think your contribution has been?
- What are your personal dreams and goals for aquatic habitats?
- What would your advice be to citizens wanting to take positive action to improve the aquatic environment?



The list of questions could be modified to include personal interests of the students and to reflect particular circumstances.

6. Once the interviews are complete, as well as any additional research, each team should write a biography about their person. Once completed, ask each of the teams to give a brief oral report to the rest of their classmates. Make copies of the biographies and send each biography with a letter of thanks to the people who were interviewed and others who assisted. It is recommended that letters of thanks be sent to all who assisted in the process.

7. OPTIONAL: Create a visual display of all the completed biographies, complete with photographs and news clippings. Invite the local aquatic heroes and heroines to the school for a public recognition of their contributions. They could be given letters of thanks and copies of their biographies at this time. The news media could be invited, including local television, radio, and newspaper reporters.

ARE YOU ME?



Objective

Students will be able to recognize various young stages of aquatic animals and match them with corresponding adult stages.

Method

Using picture cards, students match pairs of juvenile and adult aquatic animals.

Background

Many animals look significantly different in their earliest stages of development, compared to adulthood. This is obviously true for some aquatic insects. Many aquatic insects undergo metamorphosis. Metamorphosis means change during growth. Some insects experience simple metamorphosis while others undergo complete metamorphosis. In simple metamorphosis, the insect egg hatches to produce a **nymph**. Insect nymphs have essentially all the features of adults. As they grow, they are visibly similar at each stage.

Insects that experience complete metamorphosis are characterized by eggs that hatch into **larvae**. The larva grows through several stages and then changes into a **pupa**. Pupae are usually encased in a protective cover for their next stage of growth. From the pupae emerge the soft-bodied, often pale-colored, insects. They differ remarkably in appearance from their earlier forms, but are not yet completely formed. Gradually the soft pale body develops firmness and color. In complete metamorphosis, there is little

resemblance between the adult and earlier forms.

There are also remarkable similarities and differences between other aquatic animals in different life stages. The eggs of many animals hide their eventual form (alligators, turtles, birds). Pelican hatchlings, for example, may be the closest image of miniature dinosaurs to be found on the planet. Aquatic mammals often are easy to recognize. They frequently do not change as dramatically as some other animals in overall appearance as they grow from young to adult stages.

The major purpose of this activity is for students to recognize that there are differences in the life stages of aquatic animals as they grow. The students will increase their appreciation of the diversity of wildlife as well as their understanding of growth and change in animals.

Age: Grades K—2

Subjects: Science

Skills: analysis, classification, communication, comparing similarities and differences, matching, recognition, small group work

Duration: one or two 20-minute periods; preparation time for students to bring family pictures to class

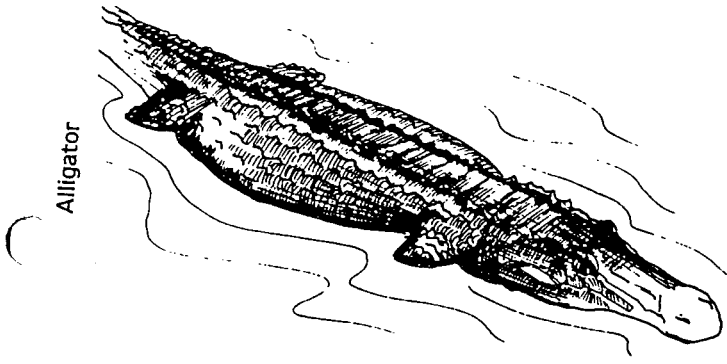
Group Size: small groups of three or four students each; card masters are provided; duplicates may be used if needed, or fewer cards if the class is smaller

Setting: indoors

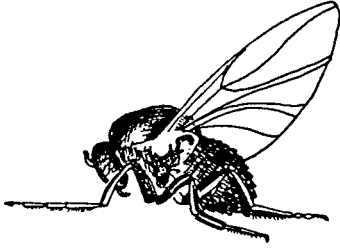
Conceptual Framework Reference: I.B., I.B.1., I.B.3., I.B.4., III.C.

Key Vocabulary: aquatic animals, grow, change, adult, young

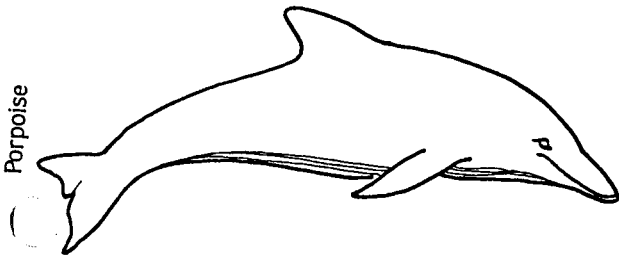
Alligator



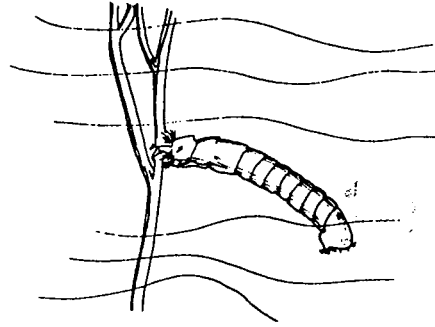
Black Fly



Porpoise



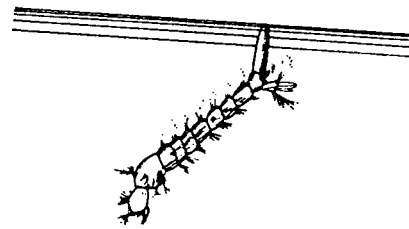
Alligator Hatchlings



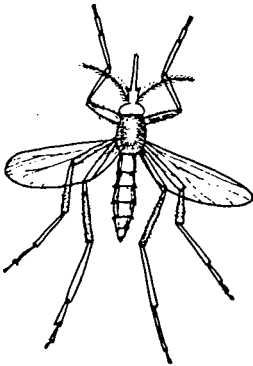
Black Fly Larva



Young Porpoise



Mosquito Larva

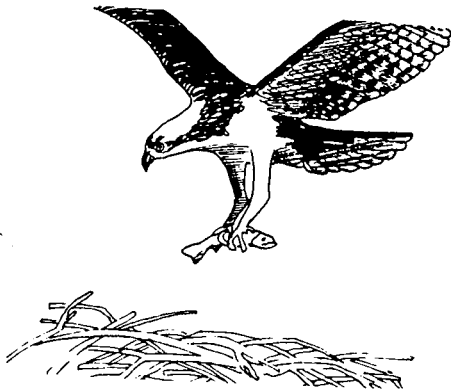


Mosquito

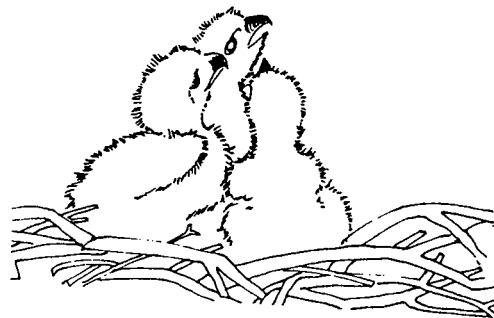


Young Beavers

Osprey

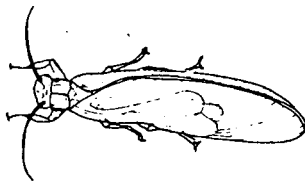


Osprey Hatchlings



Skate

Stonefly

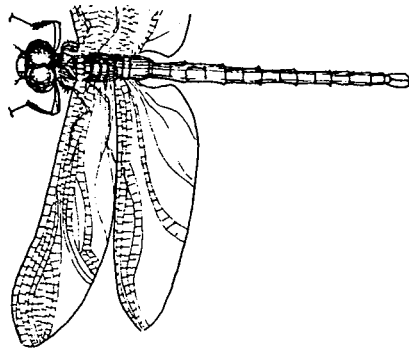


Stonefly Nymph

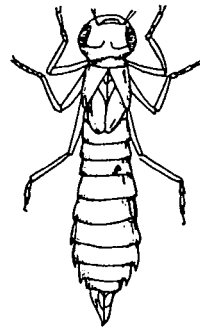


Manatee

Dragonfly



Dragonfly Nymph

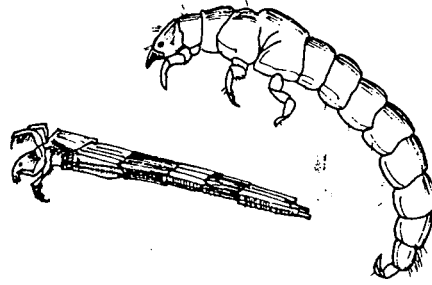


Crane

Caddisfly



Caddisfly Larvae

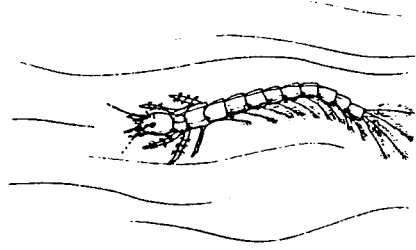


Sea Otter

Whirligig Beetle



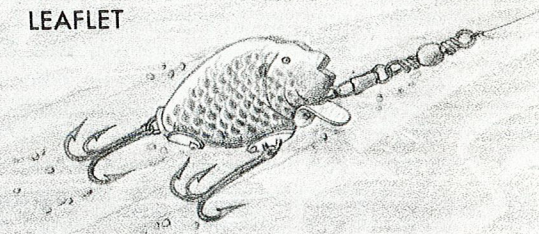
Whirligig Larva



Sea Turtle

LARGEMOUTH BASS

WILDLIFE
LEAFLET



Wildlife leaflets
are available on many mammals,
fish, & birds - write to for list
Department of Fish & Game
1416 Ninth Street
Sacramento, Ca 95814

this black bass, a popular warmwater game fish, is a member of the sunfish family

It was hot. I sat quietly in my small boat and let it drift to within about 20 feet of the bank. I was careful to not even scrape the carpeted floorboards. Studying the brushy shoreline of the slough in which I was fishing, I could barely discern the butt of a submerged log in the slightly murky water. Having decided, I cast the large floating plug to within a foot or so of the water's edge and parallel to the log. Pointing my rod tip toward the plug, I waited until the splash of the plug had completely subsided. Then, reeling in the slack line, I cautiously jerked the big plug about two inches, once, twice, when suddenly the water bulged behind the plug. Old "bucketmouth" hit the plug and with a wild splash headed down to try to go under the log. My slender rod bowed to the breaking point as I held him away from the log.

After a few heavy surging runs, the big bass floundered on the surface and dived again, then ran directly toward the boat. Guiding it around the bow, I reeled in and in a few minutes it turned on its side. Reaching over and with my thumb inside his mouth, I grasped it firmly by the

lower jaw. Temporarily paralyzed, it allowed me to lift it over the side of the boat. Enjoying the weariness in my wrist, I admired the fish and immediately guessed it would weigh at least five pounds. I was a little mystified to find that later, on the scales, it had shrunk to 3 pounds, 10 ounces. Nonetheless, it was a beautiful fish and the greenish golden-brown color did not belie the term "bronzeback".

The largemouth bass is one of the most popular of the warmwater fishes in California. It occurs in nearly all suitable lakes, sloughs and slow-moving rivers statewide. This was not always so, for the black basses, crappie and other members of the sunfish family found in California waters were all introduced from the eastern and southern states. The only one of this large family of fishes native to California is the Sacramento perch.

It is uncertain just when the largemouth was intro-

By George Seymour
Outdoor California Writer

AQUATIC ROOTS



Objectives

Students will be able to: 1) trace the origins of various species of local aquatic animals and/or aquatic plants; 2) categorize them into native and exotic species; and 3) evaluate the appropriateness of introducing new species.

Method

Students use reference materials to research various local aquatic plants and/or animals to find out whether they are natives or exotics and to investigate their impacts on people, other animals, and the environment.

Background

An exotic plant or animal is one which did not naturally occur in that specific location. It "arrived" in that location through an intentional or accidental action by humans. Exotics that survive always affect local ecosystems. Biologists usually judge the consequences of these impacts based on how much they add to or detract from some important human endeavor. They also attempt to examine the effects upon other species of animals, plants, and whole ecosystems.

Over the years, people have introduced various plants and animals into the waters and lands of our continent. Some introductions have been intentional and some accidental. Effects from

the introduction of exotic or non-native species can range from detrimental to beneficial. Some introductions may have no noticeable effect. Many times humans have a limited understanding of the variety of effects that may result from an introduction. Some introductions may have both positive and negative effects, depending on one's perspective.

Both brown trout and scaled carp were intentionally introduced into American waters from

Age: Grades 5—12

Subjects: Science, Social Studies

Skills: analysis, classification, communication, comparing similarities and differences, description, discussion, evaluation, generalization, inference, interpretation, listening, listing, mapping, problem solving, public speaking, reading, reporting, research, small group work, synthesis, writing

Duration: two or three 45-minute periods, with additional time out of class for student research and preparation of reports

Group Size: several small groups or individual students

Setting: indoors

Conceptual Framework Reference: IVE.8., IVC., IVC.4., IVE., IVE.4., IVE.5., IVE.7., IVE.9., IVE.10., IVE.11., IV.F., IV.F.1., IV.F.2., IV.F.3., IV.F.4., IV.F.5., IV.F.6., IV.F.7., IV.F.8., IV.F.9., IV.F.10., IV.F.11., IVC.1., IVC.2., IVC.3., IV.D., IV.D.1., IV.D.2., IV.D.3., IV.D.4., IV.D.5., IV.D.6., IV.A., IV.A.1., IV.A.2., IV.A.3., IV.A.4., VIC., VIC.2., VIC.12., VIC.13., VIC.15., VIC.16., VII.A., VII.B.

Key Vocabulary: exotic, native, introduced species, benefits, liabilities, tradeoffs, regulations

Procedure

1. Before starting, obtain or develop a list of common native and exotic plants and animals. Include a variety of **aquatic** plants and animals in the list. Fish and wildlife professionals and aquatic biologists are good sources of assistance. Some examples are also listed in the background information of this activity.

2. Provide the students with the list. Ask them to guess which of the plants and animals are "native" and which are introduced or "exotic." Help the students to establish clear working definitions of "native" and "exotic." A native species is one which naturally occurs in an area. Any plant or animal not naturally occurring in the ecosystems of the United States becomes an "exotic" once it is introduced.

3. If the students' "guesses" were not entirely accurate, identify the "exotics" for the students on the list that you provided them. Now focus on the "exotics."

4. Next, ask each student or small group of students to do library research about one particular species known to be "introduced" as an exotic to the area or state. Within the class, ideally a variety of introduced species will be studied. Make sure some aquatic species are included. Each student or group of students should prepare a report to be both written and oral. Have them gather information about the origins of the plant or animal and its impacts in the area. Ask them to decide whether the introduction seemed to create more benefits or liabilities for the ecosystem. They could create a two-column list of benefits and liabilities. In addition to simply listing benefits and liabilities, they should assess the importance of each item in the columns. Benefits and liabilities—positive and negative effects—may not have equal value. Some introductions may seem to have both positive and negative effects. This will be reflected when the students list items under both the "benefits" and "liabilities" columns. Some effects will be unknown, so students might also generate a list of unknown effects or questions they have for which they feel concern.

5. Ask each student or group of students to report to the class. Following the reports, encourage discussion and debate. Ask the students to identify and discuss potential tradeoffs involved. Then ask the students to evaluate the appropriateness of each of the introductions in their personal judgement, identifying and describing their

criteria. They might also consider the potential introduction of a species that is common somewhere else but is not yet in their area.

6. As a visual summary, have the students create a "network" of the exotics they studied on a world map. Stretch a strand of yarn from your location to the site of origin of each organism. Place a tag on the yarn with the plant or animal's name.

7. Preventing "accidental" introductions is also important. Develop a list of ways these introductions can occur and ways to help assure that they don't happen. Discuss the importance of laws and regulations that prevent, control, and/or allow introductions of species.

Extensions

1. Find out more about federal and local laws concerning the introduction of exotics into aquatic environments.

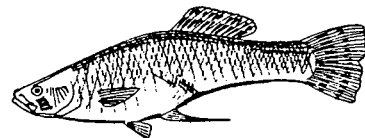
2. Investigate how humans have re-introduced some wildlife species into their original habitat where the species had previously become extinct. Have them distinguish some differences and similarities between "re-introductions" and "exotics."

Evaluation

Name three native aquatic plants and animals that exist in your area. Name three exotic aquatic plants and animals that exist in your area.

Give four reasons why an aquatic plant or animal might be introduced to an area. Are these reasons appropriate, in your judgement? Why or why not?

A local organization has proposed that a new fish be introduced into your state's rivers or lakes. List at least five questions that should be answered about the fish before the proposal is approved or rejected.



4. **(Shoveler Plant—imaginary):** This wetland plant has a special adaptation that helps it survive in overcrowded areas. As it breaks through the soil, two large, thick leaves grow on either side of the main bud. These leaves grow outward and uproot any other plants that are in the way.

5. **(Round-Leaved Sundew—real):** The leaves of this plant are covered with many short stalks. Each stalk is tipped with sticky nectar. Insects attracted to the nectar land on the stalks and become stuck. As they struggle to escape, they come in contact with more stalks and become more firmly trapped. The stalks slowly move the insect to the center of the leaf. The edges of the leaf then slowly fold around the insect, and digestion begins.

The sundew gets its name from the way sunlight glistens on the liquid-tipped hairs.

6. **(Horned Bladderwort—real):** This water-dwelling plant eats small aquatic insects and other animals. Its leaves and stalks are lined with many small, balloonlike bladders. Each bladder has a trapdoor. If a small insect brushes against the sensitive hairs around the trapdoor, it is quickly sucked through the trapdoor and slowly digested.

Bladderworts grow in the shallow waters of marshes, bogs, and swamps.

7. **(Sphagnum Moss—real):** This plant often grows in open water or on the surface of moist soil. Gas-filled cells keep it floating near the water's surface. The cells are specially designed to soak up water. In fact, each plant can absorb as much as 25 times its own weight in water! The plant uses this extra water during droughts.

Sphagnum moss is often the first plant to grow in a bog. Younger plants grow on top of older plants. As the older layers die, they eventually form thick deposits of peat. In the past, people have used the peat to heat their homes, stop wounds from bleeding, and to make super-absorbent baby diapers. Today people use it mostly to condition the soil in their gardens.

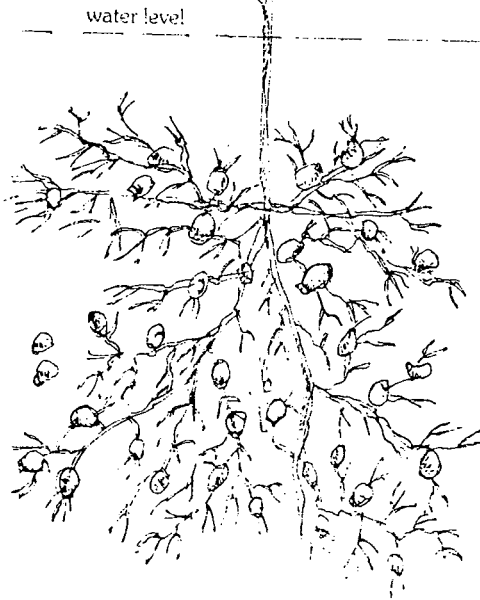
8. **(Tentacle Plant—imaginary):** This plant has long, sticky tentacles that grow out in all directions from its base. If an insect—or some other small creature—touches a tentacle, it gets stuck. The tentacle slowly curls around the victim, squeezing it tightly. Nutrients are sucked from the victim and passed through the tentacle to the rest of the plant.

9. **(Skunk Cabbage—real):** This plant begins growing very early in the spring each year—sometimes when snow is still on the ground. As the plant pushes through the soil, it produces heat by breaking down food reserves stored in its roots. The plant may get so warm that it melts the snow surrounding it! This heat helps protect its delicate flower.

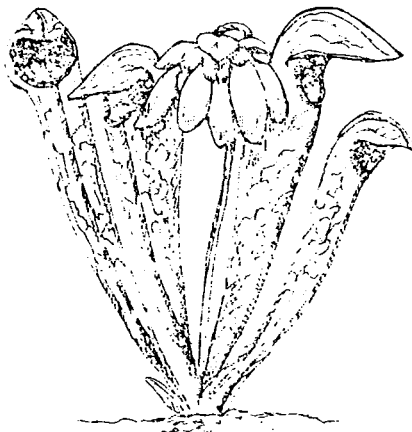
Scientists aren't sure why the skunk cabbage starts growing so early each year. But they think it must give the plant some advantage over the other plants growing in the area. Skunk cabbage has another unusual adaptation. It gives off a skunklike odor that attracts flies and other insects, which help pollinate the plant.



horned bladderwort



water level



hooded pitcher plant

BRANCHING OUT: MONSTER BOOKLETS

To help them remember what they've learned about these real wetland plants, the kids can make their own "monster" booklets. Have them color and cut out the pictures of real plants. Then they can stack three sheets of construction paper together, fold them in half, and staple them.

Finally, have them glue each picture onto a separate page and write the names of the plants below the drawings.

As a follow-up, take your group on a trip to a botanical garden in your area. Many have carnivorous plants on display.

DRAGONFLY POND

Objectives

Students will be able to: 1) evaluate the effects of different kinds of land use on wetland habitats; and 2) discuss and evaluate lifestyle changes to minimize damaging effects on wetlands.

Method

Students create a collage of human land-use activities around an image of a pond.

Background

Every human use of land affects wildlife habitat, positively or negatively. What humans do with land is a reflection of human priorities and lifestyles. The search for a modern day "good life" and all of its conveniences produces mixed results for wildlife and the natural environment. Sometimes people see undeveloped areas of natural environment as little more than raw material for human use. Others believe that the natural environment is to be preserved without regard for human needs. Still others yearn for a balance between economic growth and a healthy and vigorous natural environment. Very real differences of opinion regarding balance exist between well-meaning people.

At the core of land use issues is the concept of growth. Growth in natural systems has inherent limits, imposed by a dynamic balance of energy between all parts of the system. Energy in natural systems is translated into food, water, shelter, space, and continued survival. This means that the vitality of natural systems is expressed by their ability to be self-regulating. This capacity for self-regulation makes it possible for all natural members of an ecosystem to live in harmony. All the life forms of any ecosystem must be considered. The microbes in the soil are just as necessary to a habitat as the plants and predators. It is this natural dynamic balance, with all its inherent and essential parts, that much of human land use has tended to disturb. Human activities can often go beyond the



natural limits of a setting. Humans have the ability to import energy sources that allow a system to exceed its natural limits—or to remove energy sources that are necessary for a system to stay in balance. For example, people can build dams to create power, water can be captured for irrigation, wetlands can be drained for homes and buildings. All of these activities affect wildlife habitat.

Age: Grades 4–12

Subjects: Science, Social Studies

Skills: analysis, application, classification, communication, comparing similarities and differences, description, discussion, drawing, evaluation, generalization, inference, interpretation, invention, listening, listing, mapping, media construction, prediction, problem solving, psychomotor development, small group work, synthesis, using time and space, visualization

Duration: one to three 45-60 minute periods

Group Size: designed for a classroom of several small groups; can be modified to be an individual activity

Setting: indoors

Conceptual Framework Reference: VII.A., VII.A.1., VII.A.2., VII.A.3., VII.A.4., VII.B., VII.B.1., VII.B.2., VII.B.3., VII.B.4., VII.B.5., VII.B.6., VII.B.7., VI.A., VI.A.2., VI.A.3., VI.A.4., VI.A.5., VI.B., VI.B.1., VI.B.2., VI.B.3., VI.B.4., VI.B.5., VI.B.6., VI.C., VI.C.2., VI.C.12., VI.C.15., VI.C.16., VI.D., VI.D.1.

Key Vocabulary: land use planning, wetlands, tradeoffs, lifestyle

3. Pass out the land use materials. Pass out the 18" x 24" paper that will serve as the base for each group's pond and its associated land use activities. Have the students cut out the land use pieces and Dragonfly Pond. Tell them that all the land use cutouts must be used; park and farm land may be cut to smaller sizes, but all the pieces must be used. Parts may touch, but not overlap. The students may also create additional land uses of their choosing. When they fasten the cutouts to their large base sheet, suggest that they use small loops of tape. This will allow them to change their minds before pasting the pieces down.

4. Once the students have cut out the necessary materials and are ready to begin the process of making land use decisions, have them first create a list of pros and cons for each land use. Guide the class discussion so that they consider the consequences of each land use. Record these on the chalkboard. The following are only a few of the many possible examples:

PRO	CON
Farms:	
*produce food	*use pesticides - (herbicides, insecticides) that may damage people and environment
*economic value	*source of natural soil erosion
*provide jobs through seasonal employment	*sometimes drain wetlands for farm lands
	*use chemical fertilizers that may damage water supplies
Businesses:	
*produce employment	*produce wastes and sewage
*provide commerce	*may contaminate water (detergents, pesticides)
*create economic stability	*use chemical fertilizers (lawns, etc.)
Homes:	
*provide a sense of place	*generate wastes and sewage
*develop a sense of community	*use water
	*contribute to loss of wildlife habitat

5. Have the students work in their teams for a long enough period of time to begin to seriously grapple with the challenge.

6. Invite each group to volunteer to display and describe their work in progress. Encourage discussion of their choices. In the discussions emphasize that:

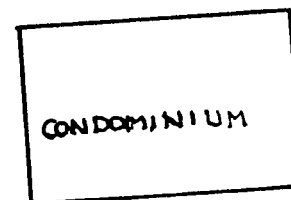
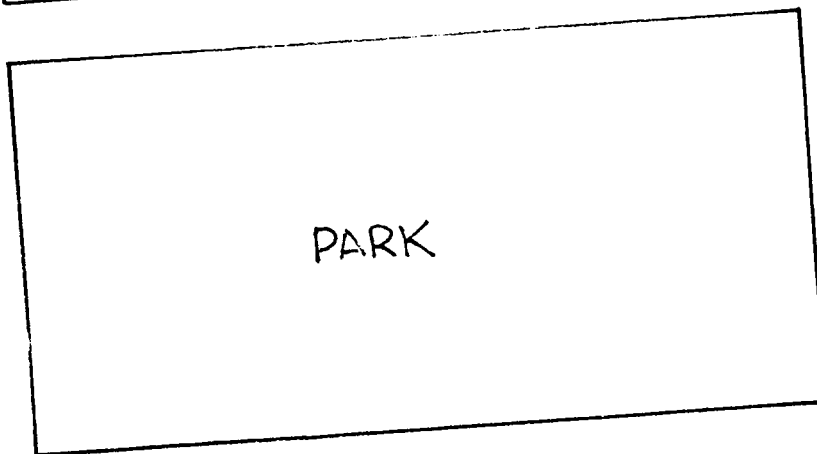
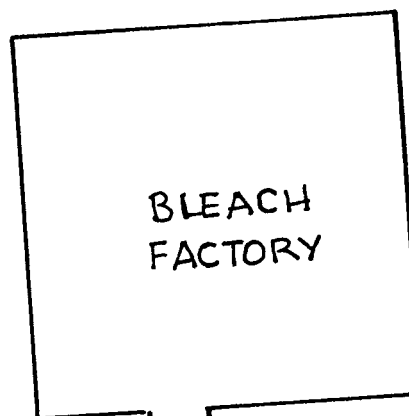
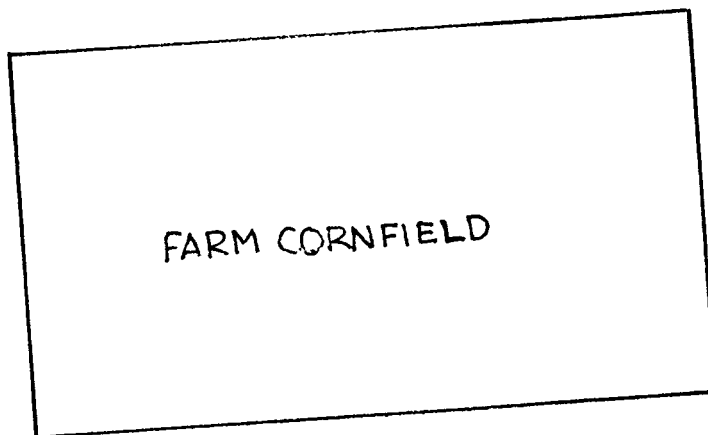
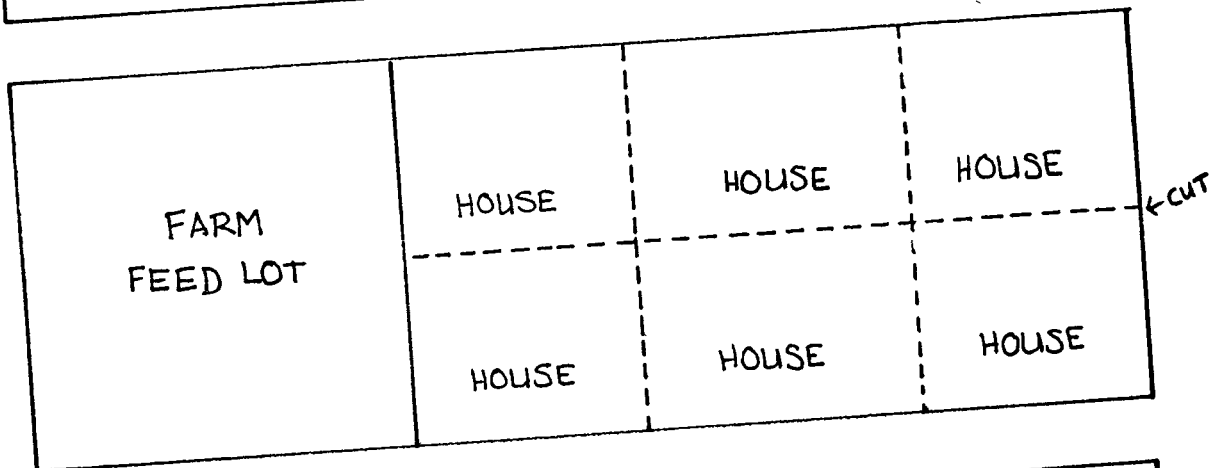
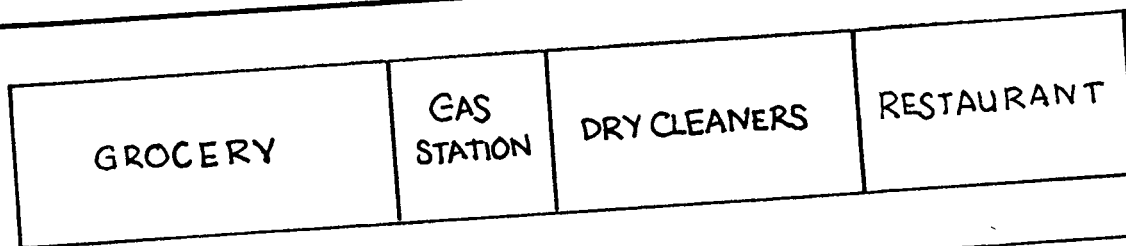
- no land use can be excluded
- wildlife habitat must be preserved
- **everyone** must agree

Look for the consequences of their proposed land use plan. Be firm about the issues, but fair about this being a very difficult set of choices. Ask additional groups to volunteer to show their work in progress, and discuss theirs similarly. NOTE: For wildlife habitat this is a "no-win" activity in many ways. The best that can be hoped for is that the land use plans will minimize the threats to the Dragonfly Pond.

7. Continue the discussion by asking more students to share their proposed plans. Again, be firm in discussing the consequences. Point out that shutting down the factory and businesses will be likely to destroy the economic base of Dragonfly Town. Abandoning the farm affects food supplies and employment. Farmlands provide habitat for some wildlife. However, if wetlands are drained to create farm land, that results in a loss of habitat for some wildlife as well as a loss of other important values of wetlands.

8. Give the students additional time working in their groups to come up with what they believe to be the best possible land use plan, under the circumstances. Being sensitive to their frustrations, display all the final land use plans above a chalkboard for all to see and discuss. Analyze and discuss the merits of each of the approaches. Point out that although their solutions may not be perfect, they can minimize the damage to Dragonfly Pond.

9. Choose one of the students' images above the chalkboard. Next, on the chalkboard, continue Dragonfly Creek downstream. Many students tend to dump effluent below Dragonfly Pond and let it flow downstream. Show the route the stream might travel. On the chalkboard drawing, have the downstream part of Dragonfly Creek become another pond and wetland, and label the new area Laughing Gull Lake. Continue the drawing to Sea Oats Estuary and finally into Gray Whale Gulf.



272

Listen to a description of a wetland and create a wetland scene with picture cut-outs.

Objective:
Identify some of the plants and animals that live in a wetland.

Ages:
Primary

Materials:
• copies of page 14
• crayons or markers
• scissors
• glue
• paper
• pictures of wetlands

Subjects:
Science and Art

Introduce your kids to wetlands by reading them a short, descriptive story about a trip to a marsh. Then have them create their own freshwater marsh scenes to become familiar with the plants and animals that live in a typical marsh.

Start off the activity by explaining what a wetland is and describing some of the different types of wetlands. (See the background information on pages 18-20 and 33-35.) Show pictures of several different types of wetlands that are found in North America. Then pass out copies of page 14 and tell the children that the plants and animals pictured are often found in freshwater marshes—one of the most common types of wetlands. Have them close their eyes and try to imagine what it's like to take a walk in a marsh as you read "In the Marsh" (see the next page).

Ask the children if they have ever explored a place like the one described. Explain that freshwater marshes like this are found all across North America. Now ask the children if they can identify the

plants and animals on the Copycat Page (see below). (The names of these plants and animals appear in the story in color.)

Talk a little bit about the plants and animals shown. See if the kids can describe how each one is adapted to living in a wetland habitat. For example, the heron's long legs help it wade in shallow water while it searches for its food. After your discussion, have the kids color in the pictures.

Next pass out a sheet of blank paper to each person. Tell the kids to draw a marsh background scene on the blank paper (see diagram). Then have them cut out their plants and animals and glue them down in their scenes to create a freshwater marsh picture. (Tell the kids to cut out each picture as close to its border as possible.) They can also draw in other marsh plants and/or animals.

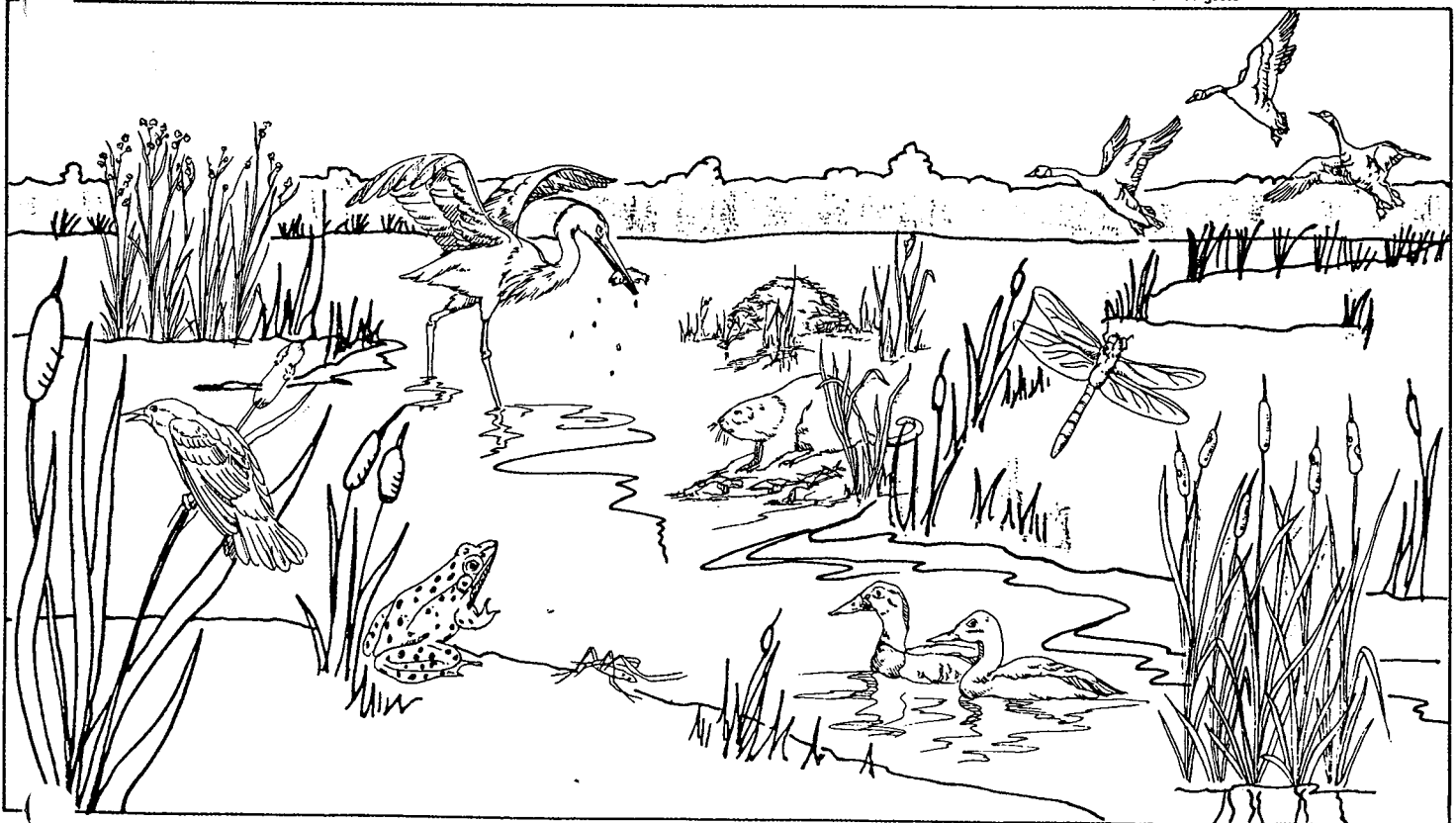
If there is a marsh nearby, take the kids on a field trip so they can look for some of the marsh plants and animals they learned about. (For more about visiting wetlands, see "Explore a Wetland" on page 8.)

(continued next page)

bulrushes

great blue heron

Canada geese



red-winged blackbird

frog

mosquito

muskrat

ducks

dragonfly

cattails

CRAFTY CORNER

Cattails for Kids

Make cattails using felt and pipe cleaners.

Ages:

Preschool and Primary

Materials:

- brown felt
- long pipe cleaners
- green construction paper
- scissors
- glue
- tape
- copies of cattail "head" pattern

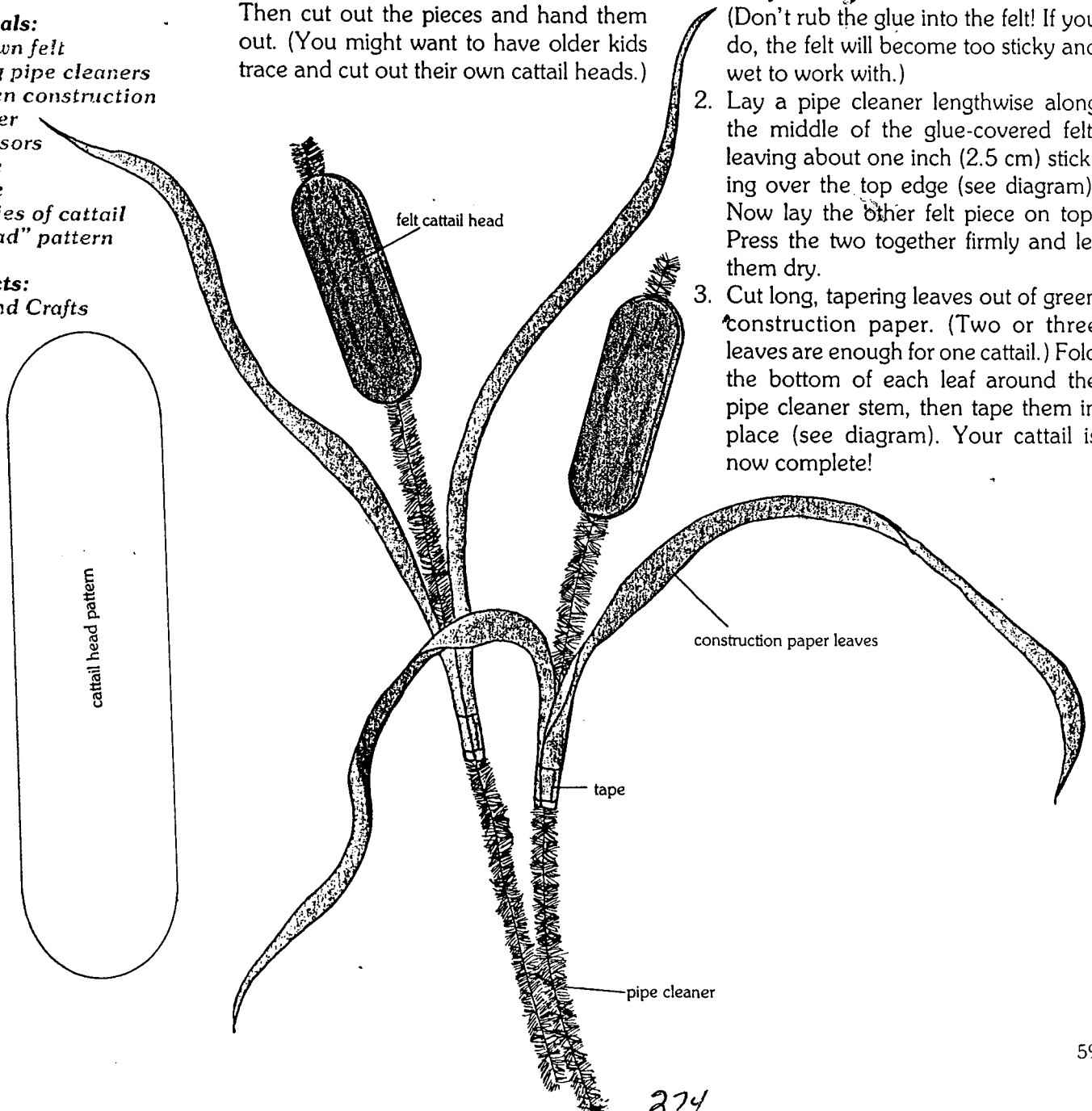
Subjects:

Arts and Crafts

Your kids can make cattails that look like the real thing! But before they start, make some cattail "heads" for them to work with. Just trace the pattern piece shown below onto brown felt, making sure you trace two patterns for each child. Then cut out the pieces and hand them out. (You might want to have older kids trace and cut out their own cattail heads.)

Provide green construction paper and long pipe cleaners, then have the kids follow these steps:

1. Put glue on one side of a felt piece, making sure you spread it evenly and fairly thickly over the whole side. (Don't rub the glue into the felt! If you do, the felt will become too sticky and wet to work with.)
2. Lay a pipe cleaner lengthwise along the middle of the glue-covered felt, leaving about one inch (2.5 cm) sticking over the top edge (see diagram). Now lay the other felt piece on top. Press the two together firmly and let them dry.
3. Cut long, tapering leaves out of green construction paper. (Two or three leaves are enough for one cattail.) Fold the bottom of each leaf around the pipe cleaner stem, then tape them in place (see diagram). Your cattail is now complete!



OPTION #2: WETLAND RESEARCHERS (FOR OLDER KIDS)

Here's a way to help your kids key in on the variety and diversity of a wetland community. Before visiting a wetland, tell the kids to pretend that they're wildlife biologists who have been hired by the state to survey the plant and animal life of the wetland you'll be visiting. The state has come up with a list of information it wants the biologists to determine. Here's a sample of the kinds of things the biologists might be asked to find out:

- the dominant plant species
- the names of other kinds of plants growing in the wetland
- a description of the soil and the creatures that live there (Do insects live in the soil? crustaceans? mollusks? what else?)
- weather conditions (temperature of the air and/or soil, wind speed and direction, percent cloud cover, and so on)
- the names of several species of birds seen in the wetland, and a description of what they were doing (flying, feeding, preening, and so on)
- the names of at least two species of insects seen in the wetland, and a description of what they were doing (flying, sunning, biting, and so on)
- the names of other animals seen in the wetland, and a description of what they were doing

- a description of any animal signs seen in the wetland (tracks, droppings, nests, lodges, burrows, and so on)
- the total number of each species of animals identified
- a comparison of plants and animals of the wetland with those of a nearby, non-wetland habitat
- the temperature of the air several feet above the ground compared to the temperature at ground level

You can either modify the above suggestions into worksheet questions that the kids can answer at the wetland, or you can come up with a chart that they can fill in during their visit. (See the example.) You might even want to have the kids come up with their own charts, as a field biologist might do. On the backs of their charts, they could jot down any information that doesn't fit on the chart, such as the descriptions of soil and weather conditions.

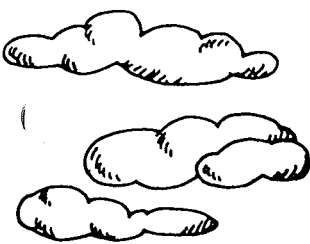



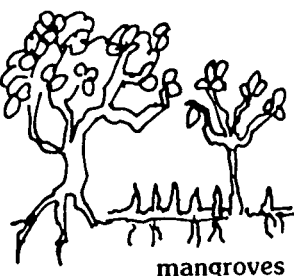
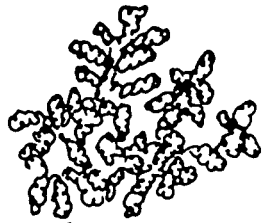









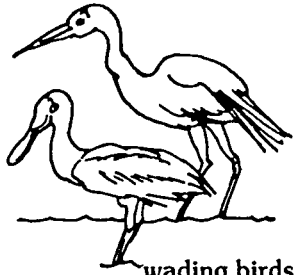



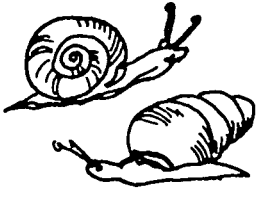






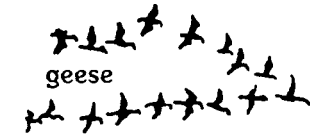
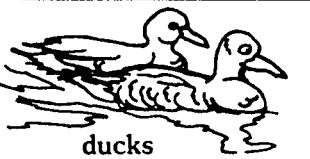

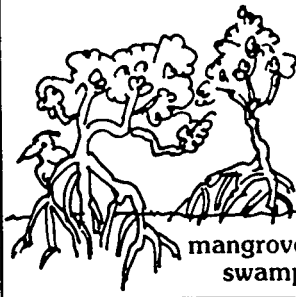
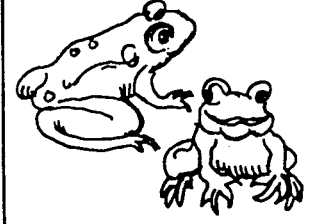
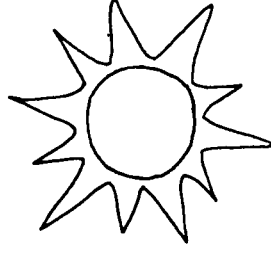




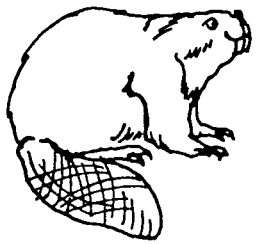
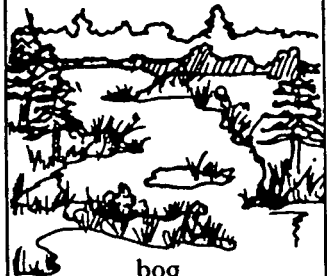
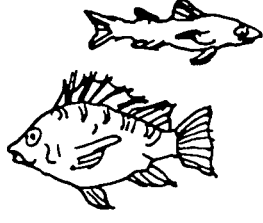
When you get to the wetland, you might want to pass out field guides for the kids to use. (The Golden Nature Guide entitled *Pond Life* and Delta Education's *OBIS Pond Guide* are two good ones for freshwater wetlands. You might want to bring bird and insect field guides too. See the bibliography for suggestions of some other field guides you can use.) Also pass out clipboards for the kids' worksheets or charts. (If you don't have clipboards, have the kids attach their sheets to cardboard with rubber bands.)

After the wetland visit, talk about all the things the kids saw. Explain that real wildlife biologists who are hired to do surveys of an area make many trips into the area to get a good indication of the plants and animals that live there. One trip usually can't reveal all of the life an area harbors. So there's probably a lot more to the wetland your group visited than they discovered while taking their surveys. You might want to try visiting the wetland at least one more time—maybe during a different season. (continued next page)

SAMPLE CHART

SURVEY OF THE SALISBURY SALT MARSH			
Plants	Animals		
	Birds	Insects	Miscellaneous
spartina (dominant) glasswort phragmites groundsel	great blue herons III snowy egrets III bald eagles I clapper rails heard III saw none	dragonflies damselflies mosquitoes grasshoppers deer flies	whitetail deer III raccoon—tracks seen snails—everywhere



 cloudy	 animal tracks	 mosquito	 dragonfly	 mangroves	 sphagnum moss
 freshwater swamp	 raccoon	  COOL	 cattails	 rushes	 muskrat or beaver lodge
 fiddler crabs	 muskrat	 wading birds	 salt marsh	 deer	
 freshwater marsh	 snails	  CALM	 pitcher plant	 sundew	 clams  mussels
 geese  ducks	 hawk	 mangrove swamp	 frogs	 sunny	
  WARM	 trees	 grasses	 beaver	 bog	 fish

FASHION A FISH



Objectives

For Younger Students Students will be able to classify fish according to body shape and coloration.

For Older Students Students will be able to: 1) describe adaptations of fish to their environments; 2) describe how adaptations can help fish survive in their habitat; and 3) interpret the importance of adaptations in animals.

Method

Students design a variety of fish adapted for various aquatic habitats.

Background

Aquatic animals are the product of countless adaptations over long periods of time. These adaptations, for the most part, are features that increase the animals' likelihood of surviving in their habitat.

When a habitat changes, either slowly or catastrophically, the species of animals with adaptations that allow them many options are the ones most likely to survive. Some species have adapted to such a narrow range of habitat conditions that they are extremely vulnerable to

change. They are over-specialized and are usually more susceptible than other animals to death or extinction.

In this activity, the students design a kind of fish. They choose the adaptations that their fish will have. Each choice they make would actually take countless years to develop. As these adaptations become part of the fish's design, the fish becomes better suited to the habitat in which it lives. Because of the variety of conditions within each habitat, many different fish can live together and flourish. Some adaptations of fish are shown in the table that follows.

Age: Grades K—12

Subjects: Science, Art

Skills: analysis, application, classification, communication, description, discussion, drawing, identification, inference, invention, media construction, public speaking, reporting, small group work

Duration: two 30-45 minute periods for older students; one or two 20-minute periods for younger students

Group Size: any; groups of four students each

Setting: indoors or outdoors

Conceptual Framework Reference: III.A.3., III.D., III.D.1., III.D.2., III.D.3.

Key Vocabulary: adaptation, coloration, camouflage, habitat

The major purpose of this activity is for students to investigate the concept of adaptation in fish.

Materials

five cards for each adaptation from the masters provided: mouth, body shape, coloration, reproduction; art materials: paper (NOTE: Body shape and coloration are the only cards needed for younger students.)

Procedure

1. Assign students to find a picture or make a drawing of a kind of animal that has a special adaptation—for example, long necks on giraffes for reaching high vegetation to eat, large eyes set into feathered cones in the heads of owls to gather light for night hunting.

2. Conduct a class discussion on the value of different kinds of adaptations to animals. As a part of the discussion, ask the students to identify different kinds of adaptations in humans.

3. Pool all of the students' pictures or drawings of adaptations. Categorize them into the following groups:

- protective coloration and camouflage
- body shape/form
- mouth type/feeding behavior
- reproduction/behavior
- other (one or more categories the students establish, in addition to the four above that will be needed for the rest of the activity)

NOTE FOR TEACHERS OF YOUNGER STUDENTS: The first three steps in the Procedures are optional for younger students. The remaining steps need only include the adaptation cards for body shape and coloration; reproduction and mouth cards are optional for younger students.

4. Divide the adaptation cards into five groups of four cards each, one each of coloration, mouth type, body shape and reproduction.

5. Pass one complete set of cards to each group of students. There might be five groups, with four to six students in each group. If the class size is larger than about 30 students, make addi-

tional sets of adaptation cards.

6. Ask the students to "fashion a fish" from the characteristics of the cards in the set they receive. Each group should:

- create an artform that represents their fish
- name the fish
- describe and draw the habitat for their fish

7. Ask each group to report to the rest of the class about the attributes of the fish they have designed, including identifying and describing its adaptations. Ask the students to describe how this kind of fish is adapted for survival.

8. FOR OLDER STUDENTS: Ask the students to make inferences about the importance of adaptations in fish and other animals.

Extensions

1. Take an adaptation card from any category and find real fish with that adaptation! NOTE: A collection of books about fish is useful. Do not be as concerned about reading level as much as profuse illustrations.

2. Look at examples of actual fish. Describe the fish's "lifestyle" and speculate on its habitat by examining its coloration, body shape and mouth.

Evaluation

For Younger Students

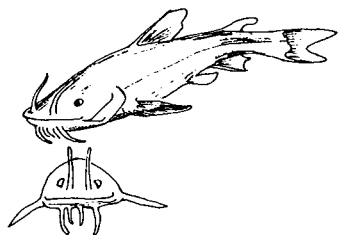
Circle the fish with vertical stripes, the one that can best hide in plants. Circle the fish with the horizontal, flat shape. Circle the fish that would be difficult to see from above. (Use the masters provided to give the students drawings of fish.)

For Older Students

Name two fish adaptations in each of the following categories: mouth, shape, coloration, reproduction. Then describe the advantages of each of these adaptations to the survival of the fish in their habitats.

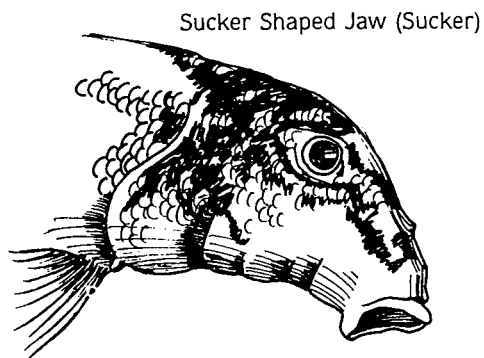
Invent an animal that would be adapted to live on your school grounds. Consider mouth, shape, coloration, reproduction, food, shelter, and other characteristics. Draw and describe your animal.

Shape



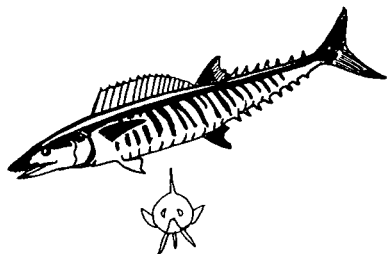
Flat Bellied (Catfish)

Mouth / Feeding



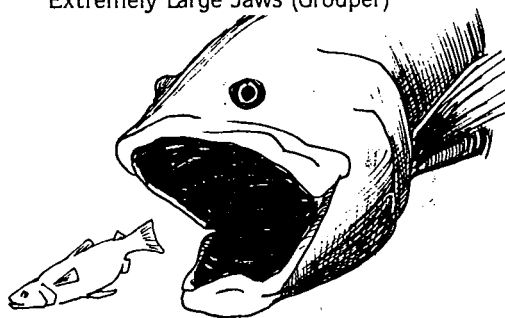
Sucker Shaped Jaw (Sucker)

Shape



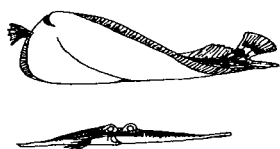
Torpedo Shape (Wahoo)

Mouth / Feeding



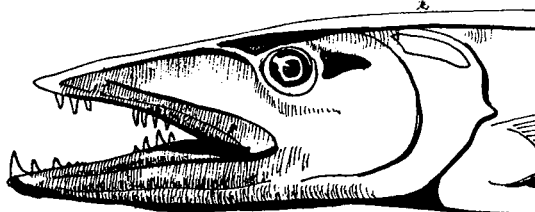
Extremely Large Jaws (Grouper)

Shape



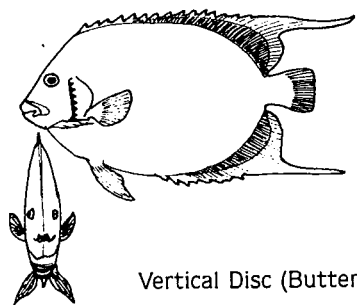
Horizontal Disc (Halibut)

Mouth / Feeding



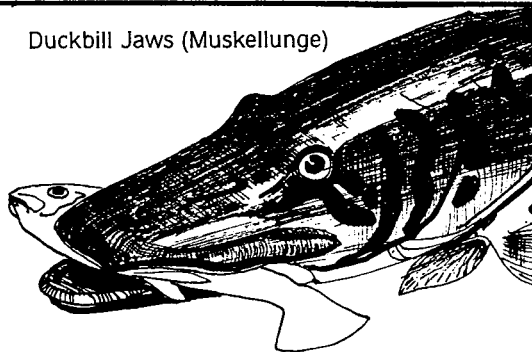
Elongate Lower Jaw (Barracuda)

Shape



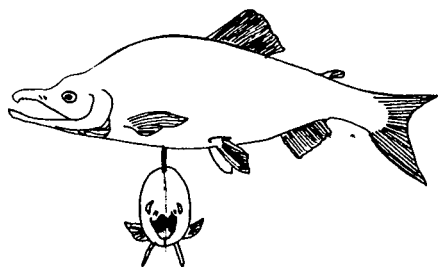
Vertical Disc (Butterfish)

Mouth / Feeding



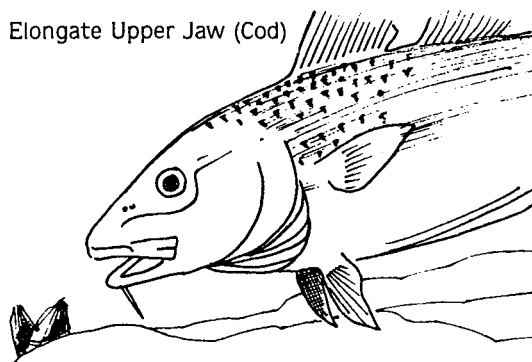
Duckbill Jaws (Muskellunge)

Shape



Humpbacked (Sockeye)

Mouth / Feeding



Elongate Upper Jaw (Cod)

HANDS-ON SCIENCE

Caring for trees

Sandra Markle

Your students may have had physical checkups, but they've probably never thought a tree might need one, too.

Announce that one of the trees on the school grounds needs its annual checkup and give each child a copy of the reproducible on page 71.

Ralph Martin, a horticulturist and tree doctor in Texas, says, "A tree can't tell you how it's feeling, but there are a lot of clues you can look for."

One sign of good health is evidence that a tree is growing. If students aren't familiar with photosynthesis, explain that healthy green leaves are essential for a tree to make the food it needs to live and grow. Measuring twig growth can also reveal a tree's health. On healthy trees, twigs grow longer each year.

"The biggest threat to a tree's general health in a city is having its root area restricted," Martin explains. "Most people think a tree spreads its roots under a concrete parking lot. It won't do that. A tree's roots have to be able to absorb oxygen from the spaces between soil particles. If the soil is compacted or covered over, there's no gaseous exchange in the soil. Without an adequate root system—one that extends at least four times beyond the size of its canopy of branches—a tree is in trouble."

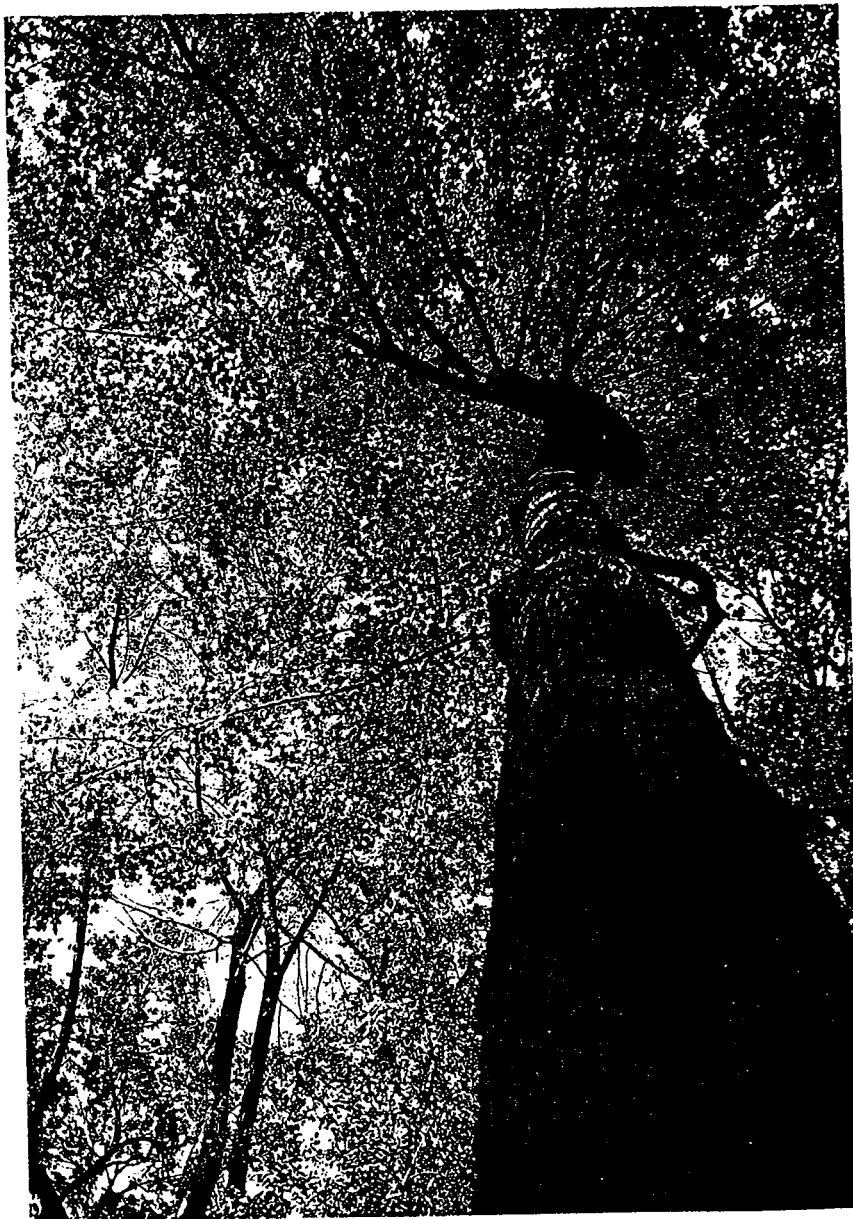
Insects can create problems for trees, too. Have students check for signs that insects have attacked the tree. They can look for breaks in the bark (wounds) that could allow fungal infections to start. Then ask them to complete the checklist.

"If the tree doesn't look healthy, or there is evidence that something

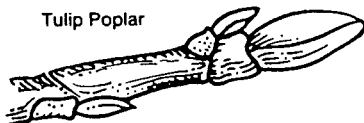
is attacking the tree, you'll want to call a professional to pinpoint the problem and provide help," Martin explains. "Besides restricted root area, the problem could be pollution, overwatering, lack of an essential mineral, a specific insect or a dis-

ease. Sometimes the tree can't be helped. But most of the time, it's possible to restore the tree to a vigorous, healthy life."

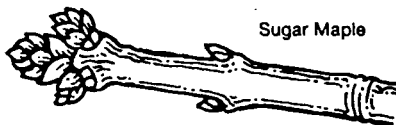
Is keeping trees healthy important? To answer, ask students to describe a treeless world.



Tulip Poplar



Sugar Maple



A tree's annual checkup

Directions: Pick a tree whose branches you can reach easily. Then perform each of the examinations below. Describe in detail what you observe about this tree's health.

1. How well is the tree growing?

A. Are the leaves normal size?

☐ yes ☐ no

B. Do any of the leaves look yellowish (when they should be green)?

☐ yes ☐ no

C. Do you see any new twig growth from the past year?

☐ yes ☐ no

D. What was the average amount of twig growth this year? (To determine twig growth, find the bud at the end of the twig. Measure from the bud to the first set of encircling rings—the location of last year's terminal bud—on five twigs. Add these measurements together and divide by five to compute the average twig growth.) _____



Beech



Black Walnut



Red Oak

2. Do you see any signs of poor health?

A. Are there any obvious wounds on the trunk?

☐ yes ☐ no

B. Are there any holes or tunnels through the bark?

☐ yes ☐ no

C. Can you see any webs, galls (bumps) or dripping sap—signs of an insect attack?

☐ yes ☐ no

If you answered "yes" to any of these questions, the tree has a health problem. Report that problem to an adult. To help you explain, describe what you saw here. _____

Conclusion: Based on your observations, how healthy is this tree? _____



American Elm



Cherry

INSTRUCTOR reproducible/Permission granted to duplicate for classroom use.

47. PLANT KINGDOM

N

TREE GEOGRAPHY

- Procedure:
1. Map out the streets around your home. Pinpoint the locations of the trees.
 2. Learn all about the different types of trees.
 3. Designate one tree in your vicinity for study all year.
 4. Observe the tree's general appearance during each season of the year.

- Questions:
1. Have the leaves changed?
 2. Are there any animals or plants living on the tree?
 3. Are the markings the same?
 4. Collect dried leaves and buds for forcing. What do they tell you about the trees?
 5. What kind of flowers and fruit are produced by the tree?

48. PLANT KINGDOM

N

TREE CLASSIFICATION

Trees are classified into two major categories:

Deciduous

Leaves fall off annually.

Warm summers,
cold winters
Broad leafed,
hardwood,
flowers and fruit

Evergreen

Leaves fall off occasionally when weathered and worn and are soon replaced, never bare.

Coniferous
Cold all year
Narrow needles,
soft wood,
cone-bearing

Tropical
Hot, wet all year
Broad leafed,
some bare,
flowers and fruit

Deciduous trees lessen activities in the winter because they can't get enough water.

Procedure: Give examples of each category. Examples: Deciduous — oak, maple; Coniferous — pine, fir, spruce; Tropical — palms.

ACTION III

Next week, tree visits should include:

1. Going over tree checklists to see what, if anything, has changed.
2. A drawing of the tree, drawn from 30 paces away from the tree, with only the tree's silhouette outlined.
3. Labeling the drawing with childrens' own special tree name.

Each week remind children to check their trees on their way to or from school. Most of the year, the Monday after lunch "Bird Nest Hour" discussion won't take long, but as spring comes there may be a crescendo of activity, perhaps culminating in daily tree visits.

Additional weekly activities might include:

1. Draw or trace one of the tree leaves. Make bark rubbings.
2. Taking water to the trees during hot September, October, or May days.
3. Composting some class lunch scraps and adding a little of this natural fertilizer to the soil above the roots. (See *Bite Your Nails, Pull Your Hair*, page 96).
4. Doing research on the kinds of tree, where each species was originally discovered and cultivated by man.
5. Write poems about your tree; see *Cinquains* on page 46 of this book.
6. Record any number of fantastic things that your tree will suggest.
7. Hold an Arbor Day tree planting.
8. Do a *Hug a Tree* investigation, (page 43).

7. The nest:

- How far off the ground is the nest?
- How far out is it from the trunk?
- What does it appear to be made of?
- How is it secured to the tree?
- How big is it?
- What kind of bird do you think built it? large or small?
- Will it last the winter?
- If not, guess when it will fall.
- If the tree is already bare, could you have seen the nest when the tree was covered with leaves?

Now name the tree after yourself, or the teacher, and two or three obvious features about the tree. (e.g., Mr. Brown's Sharp Leaf Curl Tree, Miss Carlson's Peeling Bark Tree, etc.) On return to the classroom, use copies of the observation questions to focus discussion and lay groundwork for Action II.

ACTION II

Children's homework assignment should be the "adoption" of trees with a nest or nest remnant, between their homes and school.

Have the students use their observation question sheets to record the same information on their adopted tree as you did with them on yours. Encourage them to pick names that express their trees' and their own personalities. **Leon's Greatest Green Needle Tree in the Whole World** is a fine name!

ACTION IV

m
m
m

Panel whittles away at tree list 20 cut from protections

Pd 10/16/81
61

By JO ANN GARLINGTON
Staff Writer

Literature immortalizes trees as treasures "lovelier than poems," but language in a proposed Sonoma County tree protection ordinance will chop many from a list designed to spare native trees from the developer's ax.

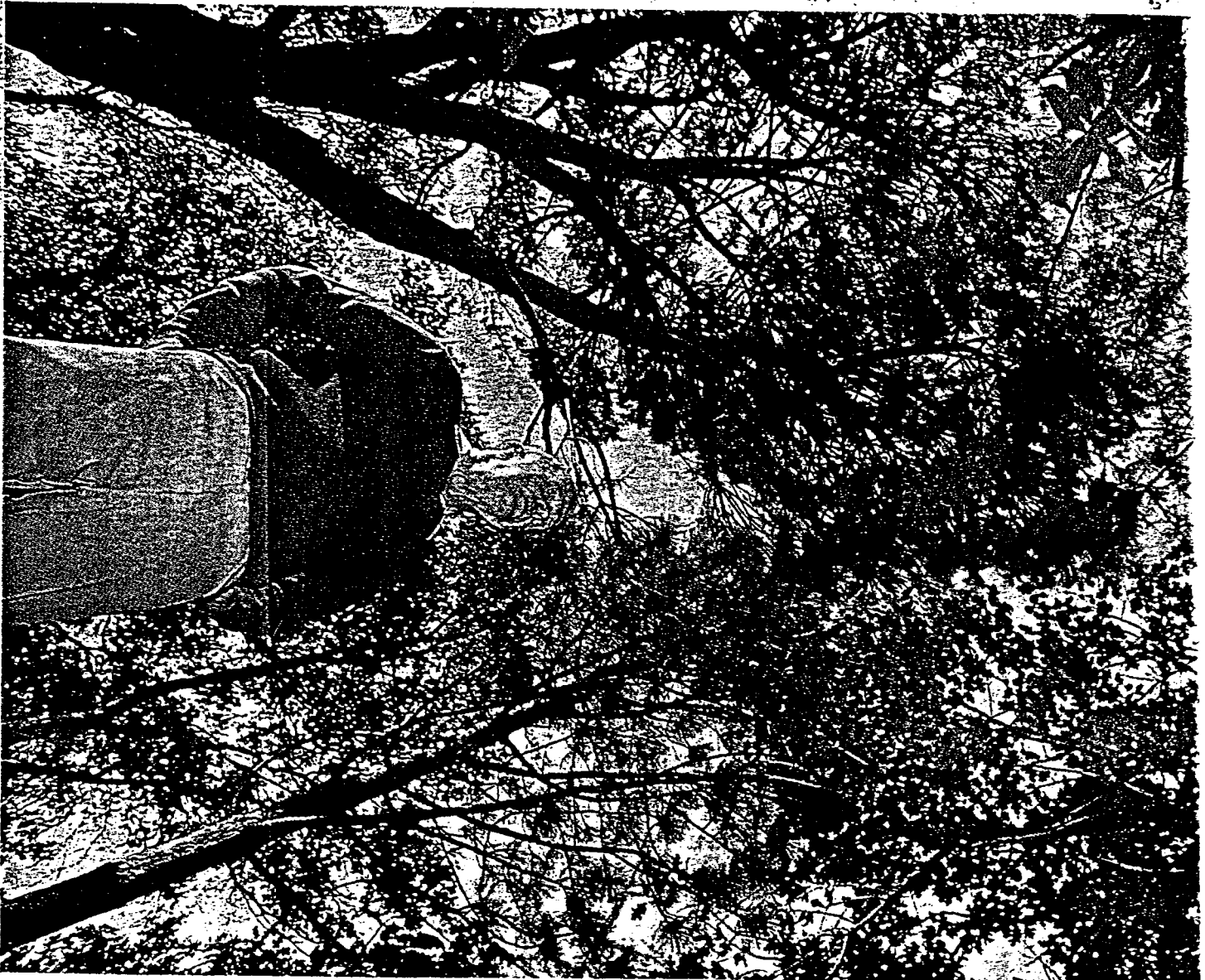
The Sonoma County Planning Commission agreed Thursday to reduce from 32 to a dozen the number of trees to be protected by the ordinance.

Environmentalists and arborists, who lobbied for the expanded list, were disappointed at the decision reached during the third public hearing on the ordinance draft.

But they conceded that protecting the dozen trees was better than cutting the list to just two species, a recommendation made by the county planning department.

"A middle ground would be good," said Ken Stocking, a retired Sonoma State University professor and environmentalist who drew up the list of trees native to Sonoma County.

Stocking said that he was appalled when he heard that planners wanted only two species, redwoods and valley oaks, to be protected by the ordinance.



RENT PORTER

See Trees, Page B2

Planning Commission chairman L...
each of the protected oak trees in a...

Celebrate Trees!

Participate in a week of tree activities.

Objectives:

Describe several ways trees are important in our lives. Explain why people celebrate Arbor Day.

Ages:

Primary, Intermediate, and Advanced

Materials:

See suggested activities for ideas.

Subjects:

Science, History, Social Studies, and Creative Writing



Bruce Norfleet

Arbor Day is a special day when people learn about, plant, and care for trees. The first Arbor Day celebration took place in Nebraska on April 10, 1872. Today, all fifty states and many Canadian provinces celebrate Arbor Day. (The date varies from state to state and province to province.) Other countries around the world also hold special tree celebrations. Here are some ideas you can try during the week of Arbor Day or anytime to help your group learn more about how they can take care of trees and conserve forest resources. We've also listed a few suggestions for some creative ways your kids can celebrate trees and Arbor Day.

- Discuss why trees are considered a *renewable resource*. Then explain why it is important to manage trees. (See "Learning from The Lorax" on page 53.) Finally discuss why it is important to conserve paper and other tree products even though trees are a renewable resource. (Planting trees and harvesting trees take a lot of money and resources. By recycling paper and other tree products, resources such as energy, people's time, and forest land, as well as tree resources, can be saved. Also, if paper consumption continues to climb, more and more land will be needed for pulpwood plantations. And that means less land will be available for native forests and other natural areas. See "Classroom Conservation" in *Project Learning Tree*.)

Then hold a school-wide or community-wide paper drive. When the paper is weighed, figure out how many average-sized trees it takes to produce that much paper. (Explain that on the average a 70-foot [21-m] tall tree that is 10 inches [25 cm] in diameter provides about 200 pounds [90 kg] of paper.)

- Use old paper to make new paper (see "Paper in the Classroom" in *Project Learning Tree* or the kits listed under "Booklets, Kits, and Posters" on page 76). You can also recycle cardboard boxes by using them to make crafts.

Hold a "recycled art" contest and have everyone make something from discarded paper products.

- Take a community walk to see where trees grow in your community and what kind of condition they are in. Talk about what the community would be like without any trees. Have someone from the planning or maintenance department in your area talk to your group about how trees are planted, why they are planted where they are, and how people in the community can help care for trees.
- As a group, plant a tree somewhere in the community. Choose a site on the school grounds, in a nature study area, or along a city block. Contact local planning officers or naturalists for advice on where to plant a tree and what type of tree would grow best. As if there's a tree planting project that your group could help with. (See "Planting and Caring For Trees" on page 76 for some resources you can use.)
- Raise money for groups that are working to save the world's tropical rain forests. (See "Support Conservation Organizations" on page 55 for more information.)
- Hold an Arbor Day essay contest and have the children write fiction or non-fiction stories about trees. Here are some suggestions for titles:
 - The Planet of the Talking Trees
 - A Day in the Life of Ollie Oak
 - An Interview With Lenny, the Lateral Root
 - The City That Grew Up Around Tree
 - What a Tree Means to Me
- Have each child come up with an advertising campaign to sell a tree product. To give it a different twist, have each person pretend to be the tree that his or her product comes from. For example, a white ash might advertise baseball bats and a peach tree might advertise peach preserves.

CINQUAIN

Cinquains are a wonderful way to combine feelings and facts about our world into a poetic image. Easy to learn; easy to do! Here's how:

1. _____
noun - one word title
2. _____
two words to describe #1
3. _____
three words to tell what #1 is doing
4. _____
four words to express a feeling about #1
5. _____
one word that means the same thing as #1

EXAMPLES:

Water

wet, cool

trickling, roaring, moving

refreshing, peaceful, energetic, soothing

Life

Cows

gentle mooing

chewing their cud

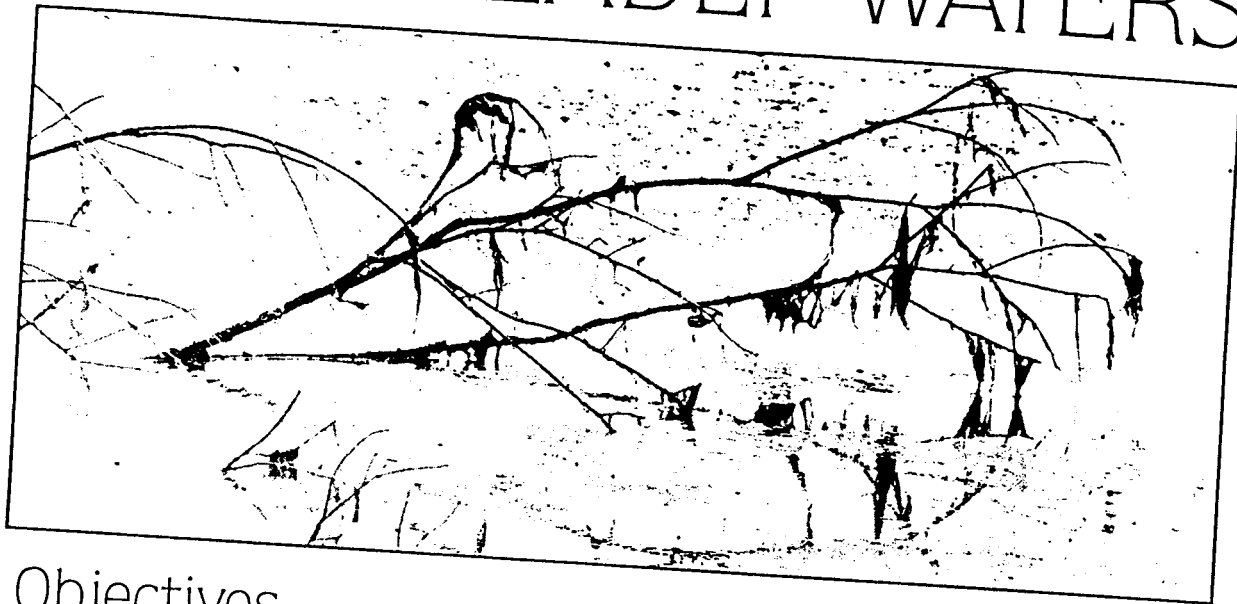
making a peaceful scene

Milk

Do this as a focusing activity, not necessarily at the end of the day, but at a time when you want them to connect, to really think about what they've experienced/observed/felt. Provide 3x5 cards and a writing instrument. This can be done alone, in pairs, or as a group activity. Please take care not to give so much instruction and so many examples that you take away their creativity. You might introduce the idea by asking them to name the one thing that impressed them the most. When you get their responses, then you can suggest that they write it down and you can give the rest of the directions. You will be wonderfully impressed with the results. Be sure to let them share with the rest. If you want a copy, perhaps you can suggest that they illustrate it when they return to school and send it to you. It is important that they keep their Cinquains. Besides being an easy way to write poetry, it gives them a reminder of something that was special to them in a special place.



DEADLY WATERS



Objectives

For Younger Students

Students will be able to name and describe different kinds of pollution that can affect water as well as animals and plants that live in water.

For Older Students

Students will be able to: 1) identify major sources of aquatic pollution; and 2) make inferences about the potential effects of a variety of aquatic pollutants on wildlife and wildlife habitats.

Waterways like rivers, lakes, and streams are a vital expression of the water cycle. All the rain and snow that falls on the land either seeps into the water table or is carried to the sea. In addition, all along the way, water evaporates or finds its way through plants and transpires back into the atmosphere to form clouds and precipitate again.

With this picture of the scale and interconnectedness of our planet's freshwater resources in mind, it is apparent how fragile this vital

Method

Students analyze the pollutants found in a hypothetical river. They graph the quantities of pollutants and make recommendations about actions that could be taken to improve the habitat.

Background

All the water that has ever been available to our planet is on or in the earth right now. On the entire planet there are 326 million cubic miles of water. If the earth were a globe 28 inches in diameter, all of the water on the planet would fill less than one cup. Of that amount, only .03% is in river systems and freshwater lakes. This means that only slightly more than one drop would fill all the rivers and lakes.

Age: Grades 3—12

Subjects: Science, Social Studies, Health, Home Economics, Industrial Arts

Skills: analysis, classification, comparing similarities and differences, computation, description, discussion, identification, inference, interpretation, matching, media construction, observation, psychomotor development, reading, recognition, small group work

Duration: 30-45 minutes or longer

Group Size: small groups of three students each

Setting: indoors

Conceptual Framework Reference: VI.A., VI.A.3., VI.A.4., VI.A.5., VI.B., VI.B.1., VI.B.2., VI.B.3., VI.B.4., VI.B.5., VI.B.6., VI.C., VI.C.12., VI.C.13., VI.C.14., VI.C.15., VI.C.16., VI.D., VII.A., VII.A.1., VII.A.2., VII.A.3., VII.A.4., VII.B., VII.B.1., VII.B.2., VII.B.3., VII.B.4., VII.B.5., VII.B.6., VII.B.7., I.A., I.A.1., I.A.2., I.B., I.B.1., I.C., I.C.1., I.C.2., I.C.3., I.C.4., I.D.

Key Vocabulary: pollution; for older students: chemical, thermal, organic, ecological, point and non-point source pollution, groundwater, toxic wastes

POLLUTANT INFORMATION SHEET

SEDIMENTS

Particles of soils, sand, silt, clay, and minerals wash from land and paved areas into creeks and tributaries. In large unnatural quantities, these natural materials can be considered a pollutant. Construction projects often contribute large amounts of sediment. Certain lumbering practices affect sediments in runoff. Sediments may fill stream channels and harbors that later require dredging. Sediments suffocate fish and shellfish populations by covering fish nests and clogging the gills of bottom fish and shellfish.

PETROLEUM PRODUCTS

Oil and other petroleum products like gasoline and kerosene can find their way into water from ships, oil drilling rigs, oil refineries, automobile service stations, and streets. Oil spills kill aquatic life (fish, birds, shellfish, and vegetation). Birds are unable to fly when oil loads the feathers. Shellfish and small fish are poisoned. If it is washed on the beach, the oil requires much labor to clean up. Fuel oil, gasoline, and kerosene may leak into ground water through damaged underground storage tanks.

ANIMAL WASTE

Human wastes that are not properly treated at a waste treatment plant and then released to water may contain harmful bacteria and viruses. Typhoid fever, polio, cholera, dysentery (diarrhea), hepatitis, flu and common cold germs are examples of diseases caused by bacteria and viruses in contaminated water. The main source of this problem is sewage getting into the water. People can come into contact with these microorganisms by drinking the polluted water or through swimming, fishing, or eating shellfish in polluted waters. Often unexpected flooding of barnyards or stock pens can suddenly increase the toxic effects of animal waste in water. Animal waste can also act as a fertilizer and create damage by increasing nutrients. (see Fertilizers)

ORGANIC WASTES

Domestic sewage treatment plants, food processing plants, paper mill plants, and leather tanning factories release organic wastes that bacteria consume. If too much waste is released, the bacterial populations increase and use up the oxygen in the water. Fish die if too much oxygen is consumed by decomposing organic matter.

INORGANIC COMPOUNDS

Detergents, pesticides, and many synthetic industrial chemicals are released to waterways. Many of these substances are toxic to fish and harmful to humans.

They cause taste and odor problems and often can not be treated effectively. Some are very poisonous at low concentrations.

INORGANIC CHEMICALS

Inorganic chemicals and mineral substances, solid matter, and metal salts commonly dissolve into water. They often come from mining and manufacturing industries, oil field operations, agriculture, and natural sources. These chemicals interfere with natural stream purification; they destroy fish and other aquatic life. They also corrode expensive water treatment equipment; and increase the cost of boat maintenance.

FERTILIZERS

The major source of pollution from agriculture comes from surplus fertilizers in the runoff. Fertilizers contain nitrogen and phosphorous that can cause large amounts of algae to grow. The large algae blooms cover the water's surface. The algae die after they have used all of the nutrients. Once dead, they sink to the bottom where bacteria feed on them. The bacterial populations increase and use up most of the oxygen in the water. Once the free oxygen is gone, many aquatic animals die. This process is called eutrophication.

HEATED OR COOLED WATER

Heat reduces the ability of water to dissolve oxygen. Electric power plants use large quantities of water in their steam turbines. The heated water is often returned to streams, lagoons, or reservoirs. With less oxygen in the water, fish and other aquatic life can be harmed. Water temperatures that are much lower than normal can also cause habitat damage. Deep dams often let extra water flow downstream. When the water comes from the bottom of the dam, it is much colder than normal.

ACID PRECIPITATION

Aquatic animals and plants are adjusted to a rather narrow range of pH levels. pH is a measure of the acidity of a solution. When water becomes too acid, due to inorganic chemical pollution or from acid rain, fish and other organisms die.

PESTICIDES, HERBICIDES, FUNGICIDES

Agricultural chemicals designed to kill or limit the growth of life forms are a common form of pollution. This pollution results from attempts to limit the negative effects of undesirable species on agricultural crop production. Irrigation, groundwater flow, and natural runoff brings these toxic substances to rivers, streams, lakes, and oceans.

took years before we could see the effects. For the most part, pollution is invisible; it often takes years to display its toxic destructiveness. Since the effects of most pollution are long term, we must develop long term views about its effects on wildlife and its habitat.

Groundwater is continually being affected by toxins we cannot see. Some pollutants enter water from a localized source, like a chemical discharge from a factory. This is called a point source pollution. Other pollutants enter from a variety of less easily identified sources; for example, when rain washes motor oil left from dripping cars in store parking lots into city drains to re-enter the water supply. This is called a non-point source pollution.

In its many journeys, water may be contaminated by thousands of different substances and conditions. For the most part these substances and conditions alter water in such ways that it becomes a hazard to wildlife, wildlife habitat, and humans as well. Some effects are direct. Others are indirect.

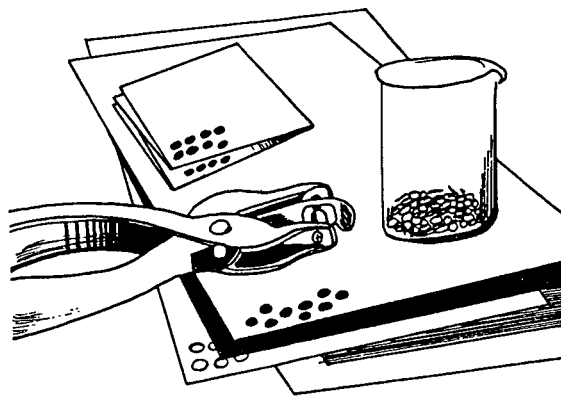
The major purpose of this activity is for students to increase their understanding of water pollution and its potential effects on human and wildlife habitats.

Materials

ten different colors of construction paper (2 sheets each); writing or graph paper; scotch tape or glue; paper punch; Pollutant Information Sheets (one for each student); $\frac{1}{4}$ teaspoon measure (for paper punch tokens); 1 tablespoon (for $\frac{1}{2}$ " square tokens)

Procedure

1. Before the activity begins, make 100 tokens of **each** of the ten colors of construction paper. The construction paper may be folded in quarters to speed up the process of cutting or punching. For younger students, cut the construction paper into $\frac{1}{2}$ " squares using a paper cutter. For older students, punch out construction paper tokens with a paper punch. Put all the tokens, either $\frac{1}{2}$ " squares or punched tokens, in a container. Stir them so the colors are thoroughly mixed.



Make one copy of the Pollutant Information Sheet for each student.

2. List the four major categories of pollution on the chalkboard and discuss each. They are: chemical, thermal, organic, and ecological. Refer to the background for a description of each.

NOTE: The first three are dominantly caused by humans, although there are rare cases where natural processes can cause them. Ecological pollution is typically natural, although there are cases where it is caused by humans.

3. Pass out the Pollutant Information Sheets. Review each kind of pollution with the students. Talk about how some of these can fit into more than one of the four kinds of pollution. Color code each with a different color of the construction paper. Write a short description of the pollution on a piece of paper of the color to which it is coded. (Some teachers have simply copied the Pollutant Information Sheets, cut the descriptions apart, and pasted the appropriate paragraphs on each of the colored sheets of paper.) Post each sheet of colored paper with its corresponding description of the kind of pollution it represents in a row in a convenient place.

4. Once all the kinds of pollution have been discussed, and the students understand that each kind of pollution will be represented in this activity by one color of paper, tell the students that they are to divide into teams of three. These will be research teams; each team will analyze the pollution content of a hypothetical river. Distribute the colored paper tokens that have been cut or punched from the construction paper. Provide $\frac{1}{4}$ teaspoon of the paper-punched tokens, or one tablespoon of the cut $\frac{1}{2}$ " square tokens, to each research team. Also provide each team with a piece of graph paper.



U.S. Population (1800-1980)

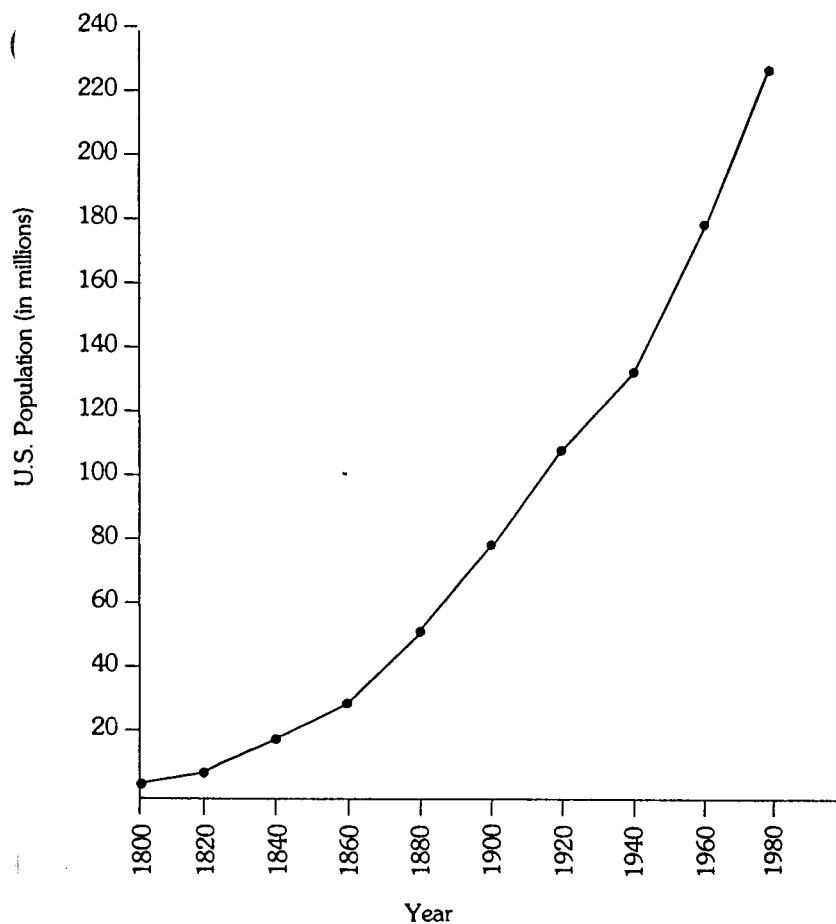


Chart #3

Number of Extinct Birds and Mammals (U.S. and Canada)		
Year	Birds	Mammals
1700-1799	0	2
1800-1899	20	4
1900-1980	19	27

Chart #4

World Population (in millions)	
1650	550
1700	610
1750	760
1800	950
1850	1210
1900	1630
1950	2520
2000	6200

Chart #1

Average Amount of Trash Generated (in lbs/person/day)	
1960	2.6
1970	3.5
1980	3.7
1986	4.5-5

Chart #2

Approximate Number of Acres of Urban Land in the U.S. (in millions of acres)	
1960	25.5
1970	34.6
1980	47.3

Chart #5

Number of Extinct Birds and Mammals (worldwide)		
Year	Birds	Mammals
1600-1649	3	2
1650-1699	6	3
1700-1749	4	3
1750-1799	4	8
1800-1849	22	5
1850-1899	48	22
1900-1949	65	59

Materials:

- markers, crayons, or poster paints
- copies of the questions provided in the activity
- cardboard
- scissors
- glue
- reference books

Subjects:

Science and Art

WETLAND QUESTIONNAIRE

1. Is there a swamp, bog, freshwater marsh, salt marsh, or other type of wetland in or near your community? If so, describe it.
2. Can you list several reasons why wetlands are important?
3. Can you name several animals that depend on wetlands?
4. Can you name two famous wetlands in North America?



Pass out one copy of the survey to each person in the group and have the kids answer each question as best they can. To get them started, talk about the characteristics of a wetland (see the background information on pages 3-4). Freshwater marshes and swamps, bogs, salt marshes, and mangrove swamps are all types of wetlands.

Afterward, collect the papers and explain that you will be discussing the answers later. Then pass out three more copies of the page to each person. Tell the kids that they should try to find three adults who are willing to fill out the survey. Give the children several days to get their surveys completed, then discuss the answers using the background information on pages 3-4. Ask the group if most of the people that they surveyed were familiar with wetlands. Have them describe some of the local wetlands that were mentioned on the surveys. Then ask them to list some of the better-known wetlands in North America. (For more about North American wetlands, see "Put It on the Map!" on page 12.) Finally, talk about how wetlands are important to wildlife. List some of the animals that depend on wetlands, including endangered, threatened, and rare species (see questions 2 and 18 on page 54).

Now tell the group that each person is going to get a chance to tell others about the importance of wetlands by designing a wetland stamp, poster, T-shirt, or bumper sticker. Explain that their creations should include a catchy slogan, as well as a design or picture that symbolizes a way that wetlands are important to wildlife. (See the drawings for some examples of slogans and pictures.) Each person can focus on a specific type of wetland or come up with a general wetland theme. Give the kids research time to find out more about the plants and animals that live in the types of wetlands they chose.

Afterward, display the finished wetland posters, T-shirts, stamps, and bumper stickers so that other people can learn more about why wetlands are important. You can also hold a contest to see which designs and slogans are the favorites.

ARE THEY IMPORTANT?

apple tree
b boo
dung beetle
earthworm
grasshopper
oak tree
penicillin mold
plankton
salmon

PART 2: WHAT'S IMPORTANT?

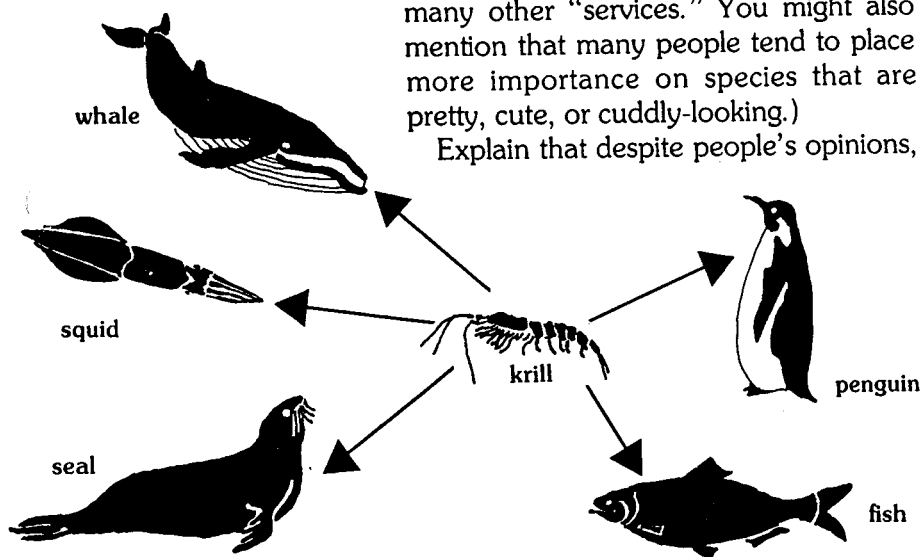
After tallying up the results, discuss why some people are often more interested in protecting birds and mammals than reptiles, amphibians, insects and other "lower" animals, and plants. Also talk about why people are more likely to want to protect large and/or beautiful species than smaller, less beautiful ones. For example, most people would probably support a panda protection program over a mouse or beetle protection program. (Some people feel that smaller animals aren't as important as larger species. Some people also feel that mammals and birds are more important than insects, reptiles, and other animals. Another feeling is that animals are more important than plants. Point out that all living things depend on plants for food, homes, and many other "services." You might also mention that many people tend to place more importance on species that are pretty, cute, or cuddly-looking.)

Explain that despite people's opinions,

all species of plants, animals, and microorganisms are important in a natural community. (You might want to point out that even though all species are important, scientists often have to set priorities based on time constraints, money limitations, and other factors.) To emphasize the ecological importance of all species, no matter how unattractive or small, use krill as an example. Describe how krill, a tiny shrimplike crustacean (see diagram), is critical to the survival of many other species. Explain that billions of these tiny creatures live in Antarctic waters and provide food for seals, squid, fish, penguins, baleen whales, and many other types of animals.

Then divide the group into several teams and give each team the same challenge: They must show how one small or not-so-glamorous animal, plant, or microorganism is important to people and/or a natural community. Give the teams research time and explain that they can write reports, draw diagrams, make murals, or do a combination of projects to illustrate how their individual plant, animal, or microorganism is important. (See the list in the margin for examples.)

As a wrap-up, tell each of the kids to have one or two adults fill out the original opinion poll. Then compare the results of the adult answers to the group's and discuss ways to educate people about the importance of all species.



The Rare Scare

Compare several imaginary animals to determine which has the characteristics of a "typical" endangered species.

Objectives:

Define endangered, threatened, and extinct.

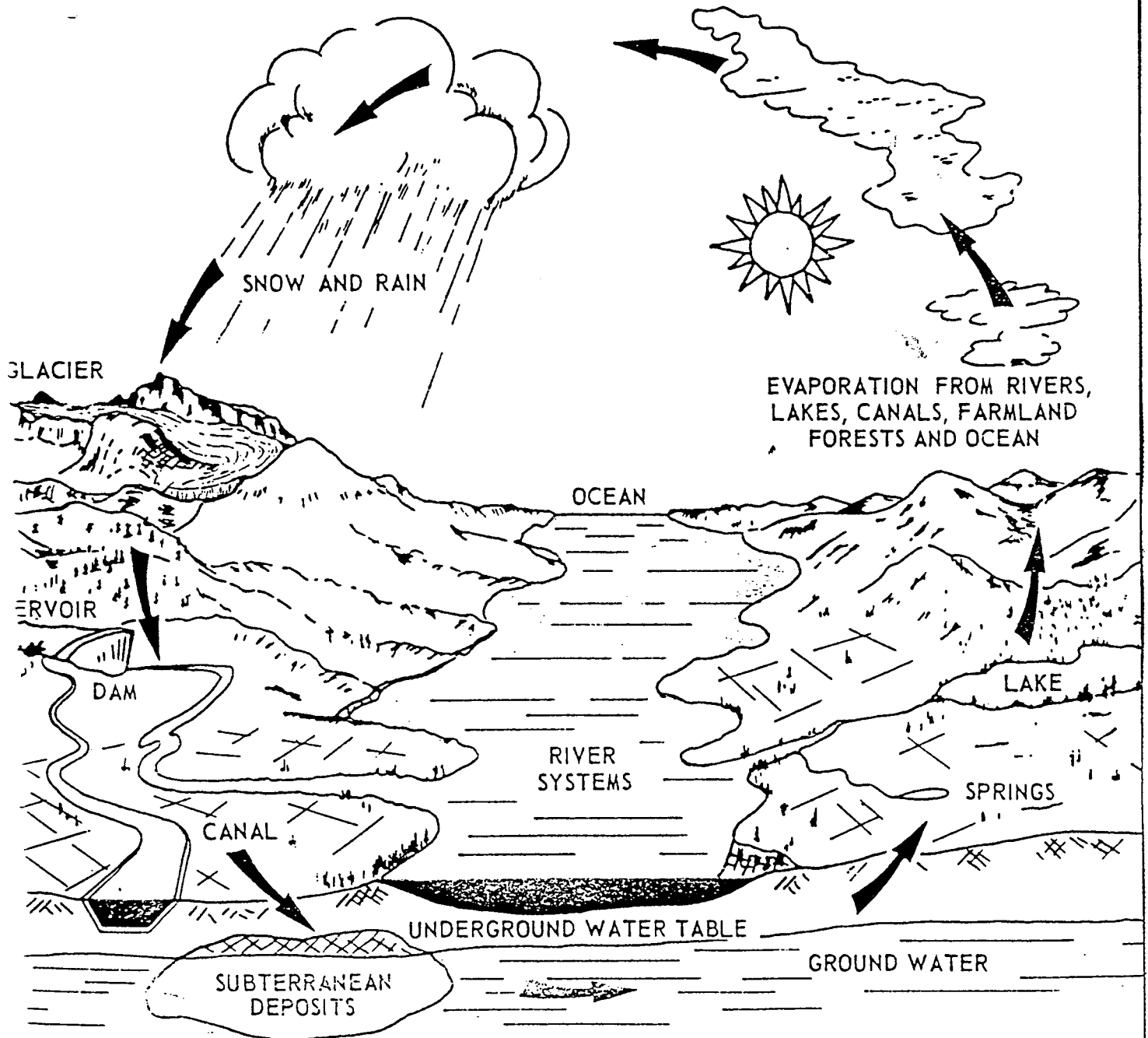
Describe several characteristics that make an animal extremely susceptible to extinction.

Rhinoceroses, pandas, condors, and many other endangered species have more in common than just their endangered status. Many share characteristics that make them extremely susceptible to becoming extinct. Start off this activity by passing out a copy of page 15 to each person. Explain that each of these animals is imaginary, but each has characteristics that are similar to those of real animals living today. Have the kids

read the information given for each animal, then have them decide which of the animals would be the first to become extinct as more and more people move into the area where each animal lives.

After each person has picked an animal, take a tally to see how many kids voted for each animal. Ask the kids why they picked these animals. Then explain that many animals that are threatened or endangered share one or more characteristics that make them more prone to

NATURE'S WATER CYCLE



WHERE DOES WATER GO AFTER SCHOOL?

Objective

Students will be able to describe relationships between precipitation, runoff, and aquatic habitats.

Method

Students measure and calculate the area of the schoolground; calculate the volume and weight of water falling on the schoolground; determine specific and annual rainfall and runoff; and trace the course of that water to aquatic habitats.

Background

Rainfall is obvious—but runoff from rainfall is a relatively abstract concept. Although we may notice and in fact get drenched in a rainstorm, we don't typically stop to wonder **how much** rain is falling. The volume and mass of the water in a rainstorm is astounding to those who calculate the values.

Developing an understanding of precipitation and runoff is an important part of understanding the water cycle. Rainfall is one form of precipitation. Rainfall is one way water re-enters aquatic habitats. Once rain falls upon a surface, water begins to move both laterally outward and vertically downward. Lateral movement is runoff and finds its way into streams, rivers, and lakes. Vertical movement seeps into the soil and porous rock and re-charges groundwater supplies.

Runoff is the dominant way that water flows from one location to another. It is in runoff that many pollutants find their way into moving waters. These are kinds of pollutants called "non-point source." What this means is that widespread sources of pollution such as garden insecticides, automobile emissions caked on parking lots, lead from paints and exhaust, etc., are washed by runoff into streams, rivers, lakes, and oceans. Eventually the water becomes part of an aquatic habitat and the toxins begin their damage.

Runoff is also responsible for erosion, transportation, and deposition of sediments scoured from the land's surface. Substandard agricultural and other land practices often prepare fields and their topsoil to be washed away.

On the positive side, much of runoff is uncontaminated. Runoff waters are necessary to

Age: Grades 6—12

Subjects: Math, Science

Skills: analysis, computation, description, discussion, estimating, inference, measuring

Duration: two 45-60 minute class periods; one period, if dimensions of the school grounds are provided

Group Size: any

Setting: outdoors and indoors

Conceptual Framework Reference: III.A.1., III.B., III.B.1., III.B.3., III.C., III.C.1., I.A.1., I.A.2., I.A.3., I.B., I.C., I.C.2., I.C.3., I.C.4., I.D.

Key Vocabulary: runoff, precipitation, volume, area, weight

2. Once the area of the schoolgrounds has been established, the next step is to determine the amount of rain that falls in the area. Three options are possible:

- Calculate the annual rainfall on the schoolgrounds using information from resource agencies, e.g., weather bureau, soil conservation service, local TV weatherpersons, local newspapers.
- Using a rain gauge, measure the amount of rain over a period of time.
- Calculate the amount of rain that falls in a given storm.

When the students have decided on a way to measure the amount of rain that falls on their schoolground during a specified period of time, ask them to calculate the amount. This provides the students with a value for the depth of rainfall on the surface of the land.

3. With the depth of rainfall determined, and the area of the schoolground measured, the next step is to calculate the volume of rainfall. For example, suppose the area of the schoolground is 50,000 square feet and the annual rainfall is six inches or .5 feet. Then the volume of rain would be:

$50,000 \text{ square feet} \times .5 \text{ ft of rain} = 25,000 \text{ cubic feet of rain}$

The volume of rain is 25,000 cubic feet of rain.

4. Knowing the volume, the students can now calculate the weight of the rain. Water weighs 62.5 pounds per cubic foot, thus the weight of six inches of rain (25,000 cubic feet) is:

$25,000 \times 62.5 = 1,562,500 \text{ pounds or } 7812.5 \text{ tons of rain}$

5. All of the measurements and calculations done in this activity are intended to impress upon students that there are remarkable volumes and weights of water moving through the water cycle. Even short periods of rainfall produce amazing amounts of water. All the water that the students measure eventually finds its way to a wildlife habitat. A major issue of concern is how humans affect the quality and quantity of water that eventually reaches aquatic habitats. Consider and discuss the following questions:

- Where does the water from rainfall go when it leaves the school site?
- How much water is absorbed by the different surfaces on the school site?
- With what kinds of potential pollutants does the water come in contact?

- Where is the location of the nearest wildlife habitat that receives the school's runoff?
- How do people use the water between the time it leaves the school and arrives in the wildlife habitat?
- What are some of the positive and negative effects that the water may have on the environment at various points on its journey?

Extensions

1. Obtain a map of the school and check it against the accuracy of the one you made. Make a copy of the school district map, or use your own map, and plot runoff routes on it. Check periodically during rainstorms to identify the drainage patterns. Try to find a way to estimate how much water is draining in specific places.

NOTE: Most school districts have maps in the administrative department concerned with buildings and grounds.

2. If you did not already, place a rain gauge on the schoolground and measure actual amounts of rain. Repeat your calculations.

3. Do this activity in metric:

100 feet = 30.48 meters

3 feet = 1 yard = .914 meter

Square feet \times .0929 = square meters

Inches \times 2.54 = centimeters

Feet \times .3048 = meters

Pounds \times .4536 = kilograms

4. A serious modern concern is the contamination of groundwater. How might water in the groundwater table or aquifer become contaminated with chemicals potentially harmful to human health? To the health of other animals, including wildlife? Identify as many sources of contamination to groundwater and runoff in your area as possible. What can, or is, being done to reduce or eliminate these sources and their effects?

Evaluation

Describe at least two relationships between aquatic habitats, precipitation, runoff, and surface water.

Name two human activities that have affected the **quality** of runoff.

Name two human activities that have affected the **quantity** of runoff.

Name two ways that runoff can affect humans.

Name and describe two ways that runoff can affect aquatic wildlife.

SOMETHING'S FISHY HEF

Objectives

Students will be able to: 1) identify potential cause and effect relationships involving aquatic-related pollution; 2) examine their personal attitudes regarding aquatic pollution; 3) generate and evaluate alternative solutions to problems of aquatic pollution; and 4) outline a plan to initiate environmental action to reduce the negative consequences of aquatic pollution in their communities.

Method

Students read and discuss a story, inventing their own endings that lead to environmental action in their community.

Background

Environmental pollution is an issue everywhere on the planet. Often individual citizens feel helpless given the scope of the problems. Yet successful action to reduce environmental problems often originates through individual actions. School children have initiated projects that improved the safety of neighborhoods, created parkland, and preserved major habitats for wildlife.

There is much to be done to protect aquatic habitats in any community. Reducing or eliminating pollution is one example of an area in which individual people can make a difference. Significant aesthetic improvement can result from reducing the most common forms of water pollution—litter and siltation. Other forms of pollution are far more elusive and more difficult to detect and eliminate. Much work needs to be done to identify and eliminate sources of pollution in ground-water, brooks, streams, lakes, rivers, and oceans. Yet in each of these habitats, aquatic wildlife is threatened—and, often, so are people!

Pollution is a term that is difficult to define. In nature, pure water cannot be found. Even as water falls from the sky, it picks up carbon dioxide and other gases and becomes more acidic and capable of dissolving some rocks. Water is known as the universal solvent, which means that it can dissolve many kinds of substances. Water also can carry suspended particles such as soil and plant material. These particles affect the penetration of light and in turn, the plants living below the surface. Water temperature and the amount of dissolved gases also change and affect the life in it.

We tend to think of pollution as something that is damaging and is unnatural, although some forms of pollution may have natural causes. Water pollution is usually described in relation to the use humans make of the water in which it is found. For example, when the conditions of a trout stream reach the point where trout die, it is then labeled polluted. That same stream was probably unfit to drink for a long time and could have been labeled polluted much earlier. It could also still support other types of fish and not be considered polluted for that species. In other words, water could be described as polluted for some purposes and not for others.

Age: Grades 2—8

Subjects: Language Arts, Science, Social Studies

Skills: analysis, application, classification, description, discussion, evaluation, generalization, hypothesizing, identification, inference, interpretation, listening, listing, problem solving, reading, reporting, synthesis, visualization

Duration: two or more 30-45 minute periods

Group Size: any

Setting: indoors

Conceptual Framework Reference: VII.A., VII.A.1., VII.A.2., VII.A.3., VII.A.4., VII.B., VII.B.1., VII.B.2., VII.B.3., VII.B.4., VII.B.5., VII.B.6., VII.B.7.

Key Vocabulary: pollution, action, responsibility

Extensions

1. Follow through on the plan to initiate environmental action to reduce the negative consequences of aquatic pollution in the community.
2. Continue working on the other issues on the list.
3. Find a way to publicize what the class has done. Contact broadcast media, the city council, garden clubs, parent-teacher association, etc.
4. Work to raise interest among other students to address additional important aquatic wildlife and habitat-related issues.

Evaluation

Name three types of aquatic pollution. Identify the pollution source. Describe some of the problems caused by each of these kinds of pollution. Water is taken from a river, treated, used by people of a community, sent to a city sewage treatment plant, and put back into the river. Is this aquatic pollution? Defend your response. Sam Smith and Jill Jones each caught their fishing line on a dead tree in a stream. They couldn't get their line loose, so cut off about 15 feet of line. Is this aquatic pollution? Defend your response.

Describe two actions that you and your classmates can take to have a clean and healthy environment.

Charlie and Alex were true friends of the "forever" type. Rarely on different wavelengths, they lived as neighbors and played together in the same coastal community for all their young lives. Both were in fifth grade.

Spring fever attacked them with equal intensity, usually right before their school's spring vacation. This particular spring, they planned to liven up the Annual Pet Show with an unusual entry. Charlie (whose name was short for Charlotte) and Alex were going to produce a "surprise" entry—some crayfish!

For many springtimes the friends had regularly captured and observed these interesting creatures. Both loved the lively and fascinating crayfish. They both learned how to handle the animals with no harm to themselves or the crayfish. They could watch the crayfish for hours in the aquarium they made for them and then return them to their habitat, unharmed. The supply was seemingly endless. Winning the prize for "Most Unusual Pet" was guaranteed.

Planning their adventure was easy as they walked from school. Charlie would bring the nets; Alex, the containers with covers.

Their science class was dealing with the subject of environmental protection. Both students liked the topic so when it was announced, Charlie and Alex gave each other the eye. Not much of a problem here in our community, they agreed. Anyway, their minds were drifting somewhere away to their secret stream. They had dreams of zillions of crayfish crawling all over the pet show poodles, birds, and fabulous felines. They could hardly wait to go to the stream.

As they walked down the woods trail, the familiar smells inspired the explorers as they anticipated their adventure. All the signs were there; the ground flowers had bloomed by the path, the willow buds were bursting, and green fuzz crowded the understory. It was "crayfish time" for sure!

They made their way down to the banks of the stream, near the deep water pools and around the grassy rock ledges. . . what anticipation! Charlie crept into the shallow water and started to probe in the rocky bottom to get the crayfish moving toward Alex. Alex was net-ready. Their adventure began to lose its luster when Charlie noticed several of the crayfish not moving at all.

THE SWIMMING HOLE TRAGEDY

The swimming hole in the Creston River below Midvale was one of the most popular places to swim, meet, and party, especially during the long, hot summer months. Even as early as May, groups in our class piled into cars after school and took off to enjoy this special spot. We had to drive five miles of unpaved road to a place where the river widened out and deepened. There we could take turns jumping off the overhanging branch of a big cottonwood tree into the cool dark waters. Most kids in town had known about this swimming hole since they were young. It was where most of us learned to swim. We went there to catch frogs and fish, and float around on old truck inner tubes. That place brought back those special memories of childhood that still seemed as fresh as yesterday, even though years had passed.

On hot, lazy, vacation days the Midvale residents would be drawn to that wet oasis to play and relax and learn some important lessons of life. It was there that I first learned that dragonfly "dive bombers" really didn't sting or sew up your lips. It's strange how those old stories get started. Sometimes I'm sorry that those myths have to die. They always added excitement and mystery to growing up and playing along the river. It was there that I learned that the best way to find stonefly larvae was to carefully lift a stone from the river bottom and scrape the clinging animals off with a leaf. It was easy to figure out how they got their name.

I reached the point where I knew almost every log that jutted out into the river's current below the surface. That was where those lunker bass hung out. I knew the locations of the best logs like I knew the back of my hand—at least until the next heavy rain and high water came along. I can still close my eyes and see the sparkle of sunlight on the rippling waters. I can feel and smell the dank moisture down under the big trees by the swimming hole. All of these memories and more made the swimming hole a special place—both in my head and in my heart. You probably know some special places in the outdoors that do the same thing for you.

No one could ever guess that such a paradise would turn our hearts so dark. This place took my sister's hearing away and came close to claiming her life. I was crushed and I never will forget the feeling. Here's how I think it all happened. One day my sister Jenny, Jeff, and I went down to swim at our favorite spot. The swimming hole

gradually had changed over the years. No one had been able to catch any big bass recently. More junk was floating downstream and the water wasn't as deep as it used to be. Fewer insects were hatching and piles of trash were gathered around fence posts.

That day we went swimming the water was especially warm and it had a greenish tinge, but that didn't stop us. In fact, we invented a contest to see who could dive down and bring up the biggest rock from the bottom. We stayed longer than usual that day and made over 50 trips diving from top to bottom. A couple of days later, we all had earaches and had to stay home from school. There was little doubt how our pains came about. We had not told our families that we were going to go to the swimming hole. When my Mom found out, she said that the river had become an open sewer. She said that we had taken our last swim in the river. It was too late for my sister, Jenny. Jenny's ears got worse and, after an intense fever, she lost her hearing forever.

We called the health department officials and soon after someone came to the swimming hole to take water samples. In fact, they took samples all along a stretch of river that passed by three towns, including Midvale. I was there to watch them take the samples. The person from the health department told me that they suspected one or more of the towns might be dumping raw sewage directly into the river. The sewage treatment plants were all over 40 years old and the towns had grown by leaps and bounds since then. Human sewage can carry germs that can cause more damage than just earaches, the official told me.

It was a long time before I could again return to the river but when I did I noticed that it was harder to find stoneflies and other creatures that lived in the river. I also noticed that the water color had become greener and murkier. It all had happened so slowly that, until our earache incident, I didn't pull all the pieces together. When I did, the conclusion was clear—even if the water in the river wasn't. The Creston River was polluted, and now I had a painful reminder that this was hurting the living things I cared about—including my sister.

It seemed ironic that the river that had taught me so much and had given me so much pleasure was now a source of danger and despair, disease and sadness. What should I do about it? Could one person make a difference? I had to. I had some important reasons to try.

2 Home Somewhere

Dan Whitmore

any place worth skin' there's a

little life makin' his home somewhere Just a

home somewhere everywhere

Mr. Raccoon in a little lagoon — works in the

night by the light of the moon — to make a home somewhere

Outside happy and free

Sam Whittemore

I like lookin' at Trees the smell of the sea the
sound of song birds singin' say hello mister sun I'm
havin' fun outside happy and free
Take a walk any Satur—day let your senses
show you Touch and smell and hear and taste Take a

Chords: D, D7, G, GM, D, E9, A7, D, D7, G, GM, D, A, D, D7, G, D, A, D, D, D, BM, BM7, E7

Ingredients and utensils for making wildland treats (see individual recipes)

Subjects:

Science and Social Studies

Cattail pollen pancake recipe reprinted from Billy Joe Tatum's *Wild Foods Cookbook and Field Guide* with permission from Workman Publishing Company, Inc.

CATTAIL POLLEN PANCAKES

- 1 cup cattail pollen (See the end of the recipe for directions on how to collect cattail pollen.)
- 1 cup flour
- 1 teaspoon baking soda

- $\frac{3}{4}$ teaspoon salt
- $2\frac{1}{4}$ cups buttermilk
- 2 tablespoons vegetable oil
- shortening or butter for frying

Sift together the cattail pollen, flour, soda, and salt. Stir together the buttermilk and oil. Add the liquid ingredients to the dry mixture, mix, and set the batter aside until it thickens (about 10 minutes). Cook the pancakes on a hot, greased griddle. (Makes about a dozen six-inch pancakes. Try folding some of them and filling them with jam, jelly, or whipped cream.)

Collecting cattail pollen: Cattails usually bloom from May through July. The pollen is bright yellow and forms on the male flower spikes, which grow up from the brown, fuzzy "sausages" of the female flower heads. To gather the pollen, just bend the cattail stalk over and shake the pollen into a bucket or bag. (Get permission from landowners or park officials before collecting cattail pollen.)

EXCEPTIONALLY EASY CRANBERRY MOLD

- 1 package raspberry gelatin
- 1 cup hot water

Dissolve the gelatin in the hot water. Pour this mixture, along with the rest of the ingredients, into a blender. Blend until the mixture becomes frothy. Pour it into an oiled mold and chill until firm.

- 1 can cranberry sauce, "jelly style"
- 1 pint sour cream

Pour this mixture, along with the rest of the ingredients, into a blender. Blend until the mixture becomes frothy. Pour it into an oiled mold and chill until firm.

Cranberries

- Wild cranberries grow in bogs and marshes. The cranberries people buy at the store are usually cultivated in specially prepared bogs in Massachusetts, New Jersey, Washington, Wisconsin, and other states.
- Early settlers called cranberry plants "crane berries" because they thought the pale pink cranberry blossoms looked like the head and neck of a crane. Later, "crane berry" got shortened to "cranberry."
- Cranberries are high in vitamin C. In the 1800s, sailors took the berries on long voyages and ate them to prevent scurvy.

- Indians ate cranberries and used them to make medicines and dyes.

Cattails

- Cattails grow in freshwater marshes and swamps.
- During World War I, cattail down (the fuzzy brown fluff from female flower heads) was used to make artificial silk.
- Indians used cattails in many ways. For example, they used the flowers to make soups, breads, and puddings, and they used the pollen to make breads. They also roasted and ate the seeds.

Mints

- There are more than 3000 different species of plants belonging to the group known as mints. Some of these plants aren't commonly known to be mints. For example, catnip, rosemary, and thyme are all mints.

- Many mints grow in freshwater marshes and along stream banks.
- Indians used mint medicinally. For example, some Indians fed their children a special mint tea to get rid of worms.
- Some mints are good sources of vitamins A and C.

Shrimp

- Many kinds of shrimp hatch at sea and then travel into salt marshes or mangrove swamps, where they grow to maturity.
- In the United States, shrimp is the most commercially valuable seafood. About three-quarters of the catch is harvested from the Gulf of Mexico.
- Some female shrimp can lay more than 500,000 eggs in less than five minutes.
- Some shrimp start their lives as males, then become females later.
- Some species of shrimp look more like tiny pears than shrimp when they hatch. They go through about 15 stages before they finally look like "real" shrimp.

TANGY MINT TEA

- 1 cup dried mint leaves (spearmint or peppermint both work well)

- 1 quart boiling water
- 1 cinnamon stick
- honey

Crumble dried mint leaves into small pieces and add them to the boiling water. Boil for about a minute, then remove the tea from the heat and let it steep for 15 minutes. For the last five minutes of steeping, add a cinnamon stick. Strain into cups. Add honey to taste, and serve hot or cold. Makes about four cups of tea.

SPICY SHRIMP DIP

- 1 five-ounce package of cooked, frozen shrimp
- $\frac{1}{2}$ cup sour cream
- $\frac{1}{2}$ cup mayonnaise
- $\frac{1}{4}$ cup mild picante sauce

- 2 teaspoons lemon juice
- 1 teaspoon prepared horseradish
- dash pepper
- dash tabasco

Thaw the shrimp according to the directions on the package and cut them into small pieces. Mix them together with the rest of the ingredients, let chill, and serve with corn chips or crackers. Makes about $1\frac{1}{2}$ cups of dip.

APPENDIX IV

FRESH WATER MARSH PLANTS OF THE LAGUNA DE SANTA ROSA

Taken from a list compiled by Nancy Harrison for the California Native Plant Society. This list includes plants that are typical of vernal pools, grassland, and various woodland communities.

Athyrium Filix-femina v. sitchense (Lady Fern)
Aster chilensis (Wild Aster)
Anthemis Cotula (Mayweed)
Alisma triviale (Native Water Plantain)
Alisma lanceolatum (Intro.)
Anagallis arvensis (Scarlet Pimpernel)
Atriplex patula ssp. hastata (Saltbush)
Amaranthus Powellii (Common Redroot)
Aesculus californica (Buckeye)
Azolla filiculoides (Duckweed Fern)
Aira caryophyllea (Hairgrass)
Alopecurus aequalis v. sonomensis (Foxtail) Rare
Alopecurus Howellii (Foxtail)
Brodiaea hyacinthina (White Brodiaea)
Brodiaea peduncularis
Brodiaea terrestris (Dwarf Brodiaea)
Boisduvalia densiflora
Boisduvalia glabella
Boisduvalia stricta
Barbarea orthoceras (Winter Cress)
Baccharis Douglasii
Brassica ssp. (Wild Mustard)
Briza minor (Small Quaking Grass)
Carex stipata (Sedge)
Carex Tracyi
Carex obnupta
Carex densa
Carex barbarae
Carex Cusickii
Carex Hassei
Cammassia Quamash
Crataegus Douglasii (Native Hawthorne)
Cornus californica (Dogwood)
Centaureum floribundum
Cirsium vulgare (Thistle)
Cicuta Douglasii (Water Hemlock)
Chlorogalum pomeridianum (Soap plant)
Cyperus niger (Umbrella Sedge)
Convolvulus arvensis (Bindweed)
Chenopodium ssp. (Figweeds)
Chenopodium ambrosioides (Mexican Tea)
Cotula coronatifolia (Brass Buttons)

Lotus Purshianus (Spanish Clover)
Lotus corniculatus (Birdsfoot Trefoil)
Lemna minor (Duckweed)
Lippia nodiflora (Lippia)
Lythrum Hyssopifolia (Loosestrife)
Lonicera involucrata (Twinberry)
Leontodon nudicaulis (Hawkbit)
Linum angustifolium (Blue Flax)
Lathyrus sp. (Pea)
Lolium multiflorum (Rye)
Lactuca spp. (Wild Lettuce)
Limnanthes vinculans (Rare Meadow Foam) Rare
Limnanthes Douglasii & ssp. (Meadow Foam)
Lilaea scilloides (Flowering Quillwort)
Myrica californica (Wax Myrtle)
Mentha Pulegium (Pennyroyal)
Mimulus guttatus (Monkeyflower)
Myriophyllum brasiliense (Braz. Milfoil)
Madia sativa (Common Tarweed)
Marrubium vulgare (Horehound)
Medicago hispida (Bur-Clover)
Melilotus albus (White Melilot)
Melilotus indicus (Yellow Melilot)
Matricaria matricarioides (Pineapple Weed)
Marah sp. (Wild Cucumber)
Machaerocarpus californicus (Star Water Plantain)
Myosurus minimus (Mousetail)
Marsilea vestita (Clover Fern)
Nasturtium officinale (Watercress)
Navarretia squarrosa (Skunkweed)
Oenanthe sarmentosa (Water Parsley)
Polygonum hydropiperoides
Plantago major (Common Plantain)
Plantago lanceolata (Buckhorn)
Polyogon monspeliensis (Common Beardgrass)
Phalaris arundinacea (Reed Canary Grass)
Picris echioides (Ox Tongue)
Perideridia Gairdneri (Yampah) Rare
Poa annua (Annual Bluegrass)
Plagiobothrys sp. (Marsh Popcorn Flower)
Pleuropogon californicus (Semaphore Grass)
Pogogyne Douglasii parviflora (Popogyne)
Quercus lobata (Valley Oak)
Rumex crispus (Curley Dock)
Rumex conglomeratus (Dock)
Rumex pulcher (Fiddle Dock)
Rumex Acetosella (Sheep Sorrel)
Rumex salicifolius (complex) (Native Dock)
Rubus procerus (Himalaya Berry)
Rubus vitifolius (Native Blackberry)
Rosa sp. (Intro) (Rose)
Rhus diversiloba (Poison Oak)

APPENDIX V

RARE PLANTS OF THE LAGUNA DRAINAGE

Blennosperma bakeri Heiser (Baker's Blennosperma) - annual; March; small golden "daisy"; grows ONLY in southern Sonoma County.

Limnanthes vincularis Ornduff (Marsh Meadow Foam) - annual; April; 5-petalled white flowers; grows ONLY in southern Sonoma County (more restricted in range than Blennosperma).

Lasthenia burkei (Greene) Greene (Burke's Goldfields) - annual; late April - May; small yellow "daisy" (larger than Blennosperma); Laguna drainage plus a few isolated vernal pools east of Highway 101.

Pogogyne douglasii Benth. ssp. parviflora (Benth.) J. T. Howell, (Small-flowered Pogogyne) - annual; May - June; cluster of small purple flowers with mint-like aromatic foliage; vernal pools only in Sonoma, Lake and Mendocino Counties.

Perideridia gairdneri (H & A) Hath. ssp. gairdneri (Gairdner's Yam-pah or Squaw Root) - perennial; July - August; like small version of Queen Anne's Lace; in other counties but very sparingly.

Milo Baker Chapter of the California Native Plant Society has mapped all these plants for the City's Data Bank. They are all on the First List (Very Rare and Endangered Species) of the "Inventory of Rare and Endangered Vascular Plants of California", Special Publication #1, California Native Plant Society, 1974.

These plants are all "vernal pool" species which are visible only from March - August. Vernal pools are a specialized habitat existing only in California and a small portion of Southern Oregon. Species restricted to vernal pools are UNIQUE and exist nowhere else in the world. CNPS is pledged to protect these plants and their habitat whenever possible. The entire issue of the CNPS publication, Fremontia, deals with the vernal pool habitat (October 1976).

Critical factors involved in protecting these plants include: no disturbance of drainage patterns, maintaining mounds and swales rather than leveling the earth; non-removal of topsoil; replacing topsoil (if removed) exactly as it occurred originally; keeping grazing pressure by livestock within reasonable bounds; avoidance of discing or packing the earth with heavy construction machinery.

-For the City of Santa Rosa, from
Milo Baker Chapter, CNPS, Rare
Plant Committee, Nancy Harrison

SPECIESSTATUS

Ruddy Duck	<u>Oxyura jamaicensis</u>	W
Hooded Merganser	<u>Lophodytes cucullatus</u>	W
Common Merganser	<u>Mergus merganser</u>	M
Turkey Vulture	<u>Cathartes aura</u>	R
White-tailed Kite	<u>Elanus leucurus</u>	R, B
Goshawk	<u>Accipiter gentilis</u>	V, Rare
Sharp-shinned Hawk	<u>Accipiter striatus</u>	W
Cooper's Hawk	<u>Accipiter cooperii</u>	W
Red-tailed Hawk	<u>Buteo jamaicensis</u>	R
Red-shouldered Hawk	<u>Buteo lineatus</u>	R
Rough-legged Hawk	<u>Buteo lagopus</u>	M
Ferruginous Hawk	<u>Buteo regalis</u>	M, Rare
Golden Eagle	<u>Aquila chrysaetos</u>	Rare
* Bald Eagle	<u>Haliaeetus leucocephalus</u>	W, Rare
Marsh Hawk	<u>Circus cyaneus</u>	W
Osprey	<u>Pandion haliaetus</u>	M
* Prairie Falcon	<u>Falco mexicanus</u>	Rare
* Peregrine Falcon	<u>Falco peregrinus</u>	Rare
Merlin		W, M
American Kestrel	<u>Falco sparverius</u>	R
California Quail	<u>Lophortyx californicus</u>	R
Ring-necked Pheasant	<u>Phasianus colchicus</u>	R
* Virginia Rail	<u>Rallus limicola</u>	
* Sora	<u>Porzana carolina</u>	Rare
Common Gallinule	<u>Gallinula chloropus</u>	W
American Coot	<u>Fulica americana</u>	W
Semipalmated Plover	<u>Charadrius semipalmatus</u>	M, Rare
Killdeer	<u>Charadrius vociferus</u>	R, B
Black-bellied Plover	<u>Squatarola squatarola</u>	M
Common Snipe	<u>Capella gallinago</u>	W
Long-billed Curlew	<u>Numenius americanus</u>	M
Whimbrel	<u>Numenius phaeopus</u>	M
Spotted Sandpiper	<u>Actitis macularia</u>	W, M
Solitary Sandpiper	<u>Tringa solitaria</u>	W, M, Rare
Greater Yellowlegs	<u>Totanus melanoleucus</u>	M
Lesser Yellowlegs	<u>Totanus flavipes</u>	M, Rare
Pectoral Sandpiper	<u>Erolia melanotos</u>	M, Rare
Least Sandpiper	<u>Erolia minutilla</u>	M
Dunlin	<u>Erolia alpina</u>	M
Short-billed Dowitcher	<u>Limnodromus griseus</u>	M
Long-billed Dowitcher	<u>Limnodromus scolopaceus</u>	M
Western Sandpiper	<u>Ereunetes mauri</u>	M
Sanderling	<u>Crocethea alba</u>	M, A
American Avocet	<u>Recurvirostra americana</u>	M, Rare
Black-necked Stilt	<u>Himantopus mexicanus</u>	M, Rare
Red Phalarope	<u>Phalaropus fulicarius</u>	Rare
Wilson's Phalarope	<u>Steganopus tricolor</u>	M, Rare
Northern Phalarope	<u>Lobipes lobatus</u>	M
Glaucous-winged Gull	<u>Larus glaucescens</u>	W
Western Gull	<u>Larus occidentalis</u>	Rare

SPECIES

STATUS

Cliff Swallow	<u>Petrochelidon pyrrhonota</u>	S
Purple Martin	<u>Progne subis</u>	M
Steller's Jay	<u>Cyanocitta stelleri</u>	W
Scrub Jay	<u>Abhelocoma coerulescens</u>	R
Yellow-billed Magpie	<u>Pica nuttalli</u>	A
Common Raven	<u>Corvus corax</u>	V
Common Crow	<u>Corvus brachyrhynchos</u>	R
Chestnut-backed Chickadee	<u>Parus rufescens</u>	R
Plain Titmouse	<u>Parus inornatus</u>	R
Bushtit	<u>Psaltiriparus minimus</u>	R
White-breasted Nuthatch	<u>Sitta carolinensis</u>	R
Red-breasted Nuthatch	<u>Sitta canadensis</u>	W
Pygmy Nuthatch	<u>Sitta pygmaea</u>	V, Rare
Brown Creeper	<u>Certhia familiaris</u>	R
Wrentit	<u>Chamaea fasciata</u>	R
House Wren	<u>Troglodytes aedon</u>	M
Winter Wren	<u>Troglodytes troglodytes</u>	W
Bewick's Wren	<u>Thryomanes bewickii</u>	R
Long-billed Marsh Wren	<u>Cistothorus platensis</u>	R
Mockingbird	<u>Mimus polyglottos</u>	R
California Thrasher	<u>Toxostoma redivivum</u>	R
American Robin	<u>Turdus migratorius</u>	R
Varied Thrush	<u>Ixoreus naevius</u>	W
Hermit Thrush	<u>Hylocichla guttata</u>	W
Swainson's Thrush	<u>Hylocichla ustulata</u>	S
Western Bluebird	<u>Sialia mexicana</u>	R
Blue-gray Gnatcatcher	<u>Polioptila caerulea</u>	M
Golden-crowned Kinglet	<u>Regulus satrapa</u>	W
Ruby-crowned Kinglet	<u>Regulus calendula</u>	W
Water Pipit	<u>Anthus spinoletta</u>	W
Cedar Waxwing	<u>Bombycilla cedrorum</u>	W
Northern Shrike	<u>Lanius excubitor</u>	W, Rare
Loggerhead Shrike	<u>Lanius ludouicianus</u>	R
Starling	<u>Sturnus vulgaris</u>	R
Hutton's Vireo	<u>Vireo huttoni</u>	R
Solitary Vireo	<u>Vireo solitarius</u>	M
Warbling Vireo	<u>Vireo gilvus</u>	S
Black and White Warbler	<u>Mniotilta varia</u>	Rare, M
Tennessee Warbler	<u>Vermivora peregrina</u>	Rare, M
Orange-crowned Warbler	<u>Vermivora celata</u>	S
Nashville Warbler	<u>Vermivora ruficapilla</u>	M
Yellow Warbler	<u>Denfroica petechia</u>	S
Yellow-rumped Warbler		W
Northern Parula Warbler	<u>Parula americana</u>	M, Rare
Black-throated gray Warbler	<u>Dendroica nigrescens</u>	M
Townsend's Warbler	<u>Dendroica Townsendi</u>	W
Hermit Warbler	<u>Dendroica occidentalis</u>	M
Chestnut-sided Warbler	<u>Dendroica pennsylvanica</u>	M, Rare
Blackpoll Warbler	<u>Dendroica striata</u>	M, Rare
McGillivray's Warbler	<u>Oporornis tolmiei</u>	M

APPENDIX VII

LIST OF MAMMALS SITED ALONG THE LAGUNA

Black-tailed Deer
Raccoon
Striped Skunk
Spotted Skunk
Gray Fox
Mink
* Weasel
Jack Rabbit
Brush Rabbit
Pocket Sopher
Mole
Wood Rat
White-footed Mouse
Meadow Mouse
Brown Bat
Hoary Bat
Red Bat
Muskrat
Gray Squirrel
* Bobcat

*Also Mountain Lion
I own property along
Laguna and have
not used mountain lion
within 1/3rd mile of
Laguna.*

From a list by Gordon Bolander

* Indicates added to list during the study.

BIOLOGICAL ENVIRONMENT
SCHEDULE FOR MAY 18 & 23

5/18

JOANN
DAVID
ROSALIND
JIM
ABBEY
GREG
PATRICK
STEVE
BRIAN
WENDY
CONNIE

5/23

DREW
JEFF
JASON
LAURIE
DENISE
SEAN
PAUL
LYNN
RONEAL
CHERYL

Purpose of these meetings is for feedback on the oral presentations and a last opportunity for feedback about written reports. If possible, turn in your finished report. It is also a time to correct errors in information which may have surfaced in the course of the study and to share, for a last time, what you have learned about the Laguna.



PROJECT PAPER
POMO INDIAN CURRICULUM UNIT
BIOLOGICAL ENVIRONMENT

CONNIE REEVES
May 10, 1989

In studying the Laguna De Santa Rosa I chose to focus on the Laguna from an educational aspect. If the Laguna were to become a refuge the educational opportunities to be found would be numerous. I chose to focus my study on the historical view of the Pomo Indians. The Pomo's were at one time the inhabitants of the Laguna De Santa Rosa. I spoke to several elementary school teachers, and all seemed to be interested in what could be done educationally within the Laguna environment. The Laguna as an educational tool could provide experiences for learning about; biology, science, history, environmental awareness, conservation, to just name a few.

The Southern Pomo who lived in the Laguna were separated by two Pomoan tribelets; on the west side lived the Kamhomtara, while on the east side of the Laguna lived the Betakmtara tribe. The project I have put together has been separated into different aspects of Pomoan life, consisting of; social-political structure, language, birth, death, childhood and adulthood, marriage, ceremonies, and attitudes held toward the environment. In doing this I felt that this would give the teacher a better and more complete understanding of Pomoan life style and background information. Along with the guide in a section of additional resources available to supplement the unit. The activities I have included in the packet give the children hands on experience in the Laguna setting as well as increase the conventional educational skills, along with increased awareness of the environment. The packet has been geared towards a third through sixth grade levels, but can be adapted for younger or

older children.

LANGUAGE

The Indians who lived in the Lagune De Santa Rosa were of Southern Pomo dialect, one of the seven distinct Pomo languages. The languages received their geographical designations based upon their location via the Russian River drainage, Northern, Central, Eastern, Southern, South Western, South Eastern and North Western. Because, of shared linguistic relationships, the seven languages are referred to collectively as the Pomoan family of languages. The Pomoan family is, in turn, a member of the larger Hokan stock of families. Speakers of the Pomoan languages controlled the territory drained by the Russian , South Fork of the Eel and the Navarro Rivers, and most of the Clear Lake Region.

Southern Pomo is the name of the seven Pomo languages and of its speakers. The Southern Pomo never formed a political unit but were simply those village communities that shared the same language. The Southern most of these were in the Lagune De Santa Rosa and Sepastapool. West of the Laguna was the tribe Komhomtara, east of the Laguna were the Betakmtara Pomo's.

THE LAND

To the Pomo belonged the land which the members traveled on, lived on, collected food from, and were buried in. Tribe territories were usually within range of water in this case being the Laguna De Santa Rosa. The entire territory owned by a

tribelet was used; some parts intensively, others seasonally or occasionally. The whole territory formed a unit, some part of which was used in one way or another during the year. The Southern Pomo followed a regular routine of living by a river or a creek, above flood level in the winter; then, as spring came they moved from the central towns to temporarily occupied summer settlements to collect greens and seeds, bulbs, and as the year wore on , fruits, berries, and finally nuts and acorns. Fishing was usually the best in the winter and spring; hunting more productive in the summer and fall.

The Southern Pomo did not plant crops with the exception of tobacco, and did not raise animals with the exception of the dog. They did use, however, good environmental management techniques such as restrictions on hunting and fishing to ensure future supplies. These were sophisticated management procedures. The Pomo were not growers of food but rather complex collectors and hunters.

Most materials used for clothing, houses, tools and other articles of daily use were made of local materials found within their territory. Rare, unusual, or locally unavailable materials were traded for with other groups to offer in trade to their usually abundant local foods. They were the manufacturers and suppliers of small disc shell beads for all the North-Central California tribelets and were also well known for their excellent drills.

While the demand for some trade items was predictable year to year, the size of certain food harvests such as acorns and salmon

often varied. To offset local shortages all tribelets participated from time to time in the exchange or purchase of basic foods when an over abundance of a particular food occurred, the well-endowed group would host a "trade feast" and invite other tribelets to enjoy the harvest.

There were considerations other than material resources that affected the Indian use of the land. Each tribelets territory contained many places which had sacred or historical association to its inhabitants. Some landmarks were dangerous, some were associated with good luck, some were sacred, but all of them were named and respected and were an important part of life. Connection with the past and the ability to deal with the future were associated with the one's home base, anything far beyond was associated with danger. Allied to these facts was the tremendously strong attachment that California Indians had for the place where they were born, raised, and lived out their lives.

CYCLE OF LIFE

In the Komhomtara and the Betakmtara cycle of life each person moved through a series of well defined stages as they grew from childhood to old age, entering the transitions with the knowledge that they had not only the social, but also the emotional support of their families, friends, and communities.

BIRTH

The birth of a child was especially important occasion. Although marriage united a couple and their respective families socially, it was only through the birth of a child that brought them together, Child rearing was the primary responsibility of the

mother, mother in-law and their closest relatives, including older men. A month or more after birth a child received its name in a special ceremony, and was placed in a traditional baby carrying basket made by men, the basket was usually crafted by a close relative of the father. The infant was wrapped in a fur blanket and made secure in the basket. (see picture, next page.)

CHILDHOOD

Children spent much of their time listening to "coyote stories", stories of when the animal people and supernatural were the only occupants of the world. They also played a variety of games. These were more than recreational and entertainment , they were experiences by which a variety of life skills were taught. The following story illustrates one of the social values taught to children:

Two brothers, who were small birds with black crests, were orphans. They were raised by a very old lady, who they called grandmother. This was before people... Coyote also lived then, and there were lots of other birds. It was a time of starvation.

One day Coyote was laying on his back singing at the moon. He was so proud of himself and his song. And slowly all kinds of breads came from heaven in a disc. All kinds of Indian bread were in it. Coyote was proud instead of humble. He had sung about his hunger in a proud way. When something is asked for, one should be humble. When it is received, a thanks should be said. Instead Coyote was just proud , laid there on his back next to the bread, put his hand, took some bread, put it in his mouth and said 'um. And then he sang some more. He did this four times. Each time , the disc moved a little farther from Coyote. On the fourth move, it rolled away with all the bread. He called for help to the people. Everyone was running, trying to catch the bread.

Then those two little birds said to their grandmother "we're going to catch it." Everyone else set nets in the best places. The poor birds then set theirs in the only place left. They rigged their poor net, which was torn and sad, over a hole in the brush. The bread rolled into the net. Both of them ran up and stuck their heads into the



bread and got their bellies full. Then they grabbed some bread for their grandmother and went home. The people all got the rest. Coyote who had been too proud got none. (Peri, Petterson, McMurray 1984:155).

as they grew, children took on the responsibility of collecting and carrying wood. assisting in food collection and supervising young children. It was the responsibility of the oldest to help the younger ones. Boys were instructed in hunting, trapping, and fishing, and in the ways of men by their father and his older male relatives. Girls were trained in domestic arts of basketry, food collection, cooking and in the ways of women by her mother and her older female relatives. The more accomplished they became in their skills, the more they were allowed to participate in the world of adults. Young boys also learned to weave from their senior female and male relatives. However, only women wove the finer and more complex baskets the Pomo's are famous for.

ADULT LIFE;

Although there was no single event which marked a person's passage into adulthood, it was usually associated with marriage. However, there was no criticism of those who remained single. An additional stage of adulthood was marked by the birth of children. Not only was the couple given a new role and position but, also their parents who became grandparents, and also brothers and sisters who became aunts and uncles. In fact, the birth of even one child brought new privileges and responsibilities for those related by blood and by marriage to the child.

Adult life for a man consisted of a number of activities, varying according to his own age or status. In addition to family

life and participation in the politics of his own and tribelet the, vast majority of men engaged in hunting, fishing, collecting, tool making, and maintenance building and ceremonial activities. For women, in addition to domestic activities, there were also opportunities to specialize. The tribelet's headman's wife generally presided over the affairs of women . Some women, specialized in making certain baskets, midwifery, herbalism, and singing.

Shortly after their recognition as adults men and women become eligible for marriage. Marriage not only joined a couple in a special relationship but also joined families, towns, and other tribelets who then ideally related to each other in a mutually cooperative supportive manner. Marriage, therefore, was not only a social arrangement, but a political one as well. Marriage was not allowed between close relatives.

There was a number of socially approved occasions for unmarried men and women to meet. These included, inter-town and inter-tribelet events, such as, communal summer fishing activities, recreational, trading and ceremonial events. If a man liked a particular woman, he would inform his parents and they would try to arrange for the couple to formally get together by giving gifts to the woman's parents. If her parents accepted the gifts, they accepted the suitor, his family and their children. If, however, they refused the gifts outright, the man and his parents would become upset, often causing bad feelings between the two families. Such relationships had the chance for getting out of hand, with one or both families resorting to supernatural

means and or poison to bring about sickness, misfortune, or possibly death.

Courtship was, therefore, not taken lightly; it was a serious affair. The giving and accepting of gifts was a serious and formal occassion. If these occassions were not mutually acceptable then, the courtship would be tactfully discouraged, in order that bad feelings did not arise. Also, since these families might find themselves involved in other courtships, they needed to protect their rights to enter into future relationships. It was during courtship that both parties attempted to provide each other with examples of the quality of their upbringing and reveal themselves as the individuals they were. Courtship was often short, with the man about sixteen to seventeen, and the woman fourteen to sixteen when they married.

Marriage partners were allways selected from outside the group that one called their relatives., and were often chosen from another community or tribelet of other Pomoans. However, for the vast majority of marriages, couples were able to speak each other's languages. Exceptions were the sons and daughters of socially politically important families. These exceptions created or strengthened strategic social and political ties between communities and tribelets enhancing and enlarging the opportunities of each.

After marriage the groom was obliged to help his in-laws collecting firewood, and sharing the results of his hunting and fishing activities. Likewise, the bride was obliged to assist the grooms mother in her work.

Most generally a newly married couple lived near the home of the groom, although they often went to the home of the bride for short periods of time. Married men lived in the sweat houses with other men. They returned to their homes for meals, but often slept in the sweat houses. Here they developed comradeship, exchanged information, learned from the more experienced and planned male centered events, such as, hunting and fishing.

OLD AGE

People were considered old when they reached their forties. Although they lacked the vigor and stamina of younger people, older people, by virtue of their experiences were skilled and their abilities were put to good use. Senior men assisted in getting food, made and repaired nets and other items, dressed hides, fashioned ceremonial materials, and made clam shell beads. Senior women also assisted in food and preparation, continued to make baskets, fashioned clothes, and made twine and rope. Elders associated their materials and other children through times of emotional stress. They also cared for and educated their grandchildren, and as such insured the continuity of traditional ways and beliefs into the future.

Individually and collectively, elders were the repositories of the centuries old history, and the scholars of their cultural traditions. It was they who provided a vision of stability in which the experiences of others could be appraised and learned from. As such, elders were able to contribute to a future in which change was not avoided, but rather seen as being part of nature and the order of their world.

DEATH

When someone died all his belongings, property was destroyed. The family burned his body and his things. Everything that was around the dead person was destroyed. Whatever they owned went with them, their baskets, tools, dancing gear, etc. The name of the deceased was never mentioned, at least never as long as it was remembered. To remember the dead in such a way that would cause them to want to remain among the living was unacceptable. The dead could only find their new lives from being freed from their earlier existence. Materials associated with the deceased were destroyed so the dead would not long for them and return to seek them out. Unless death was immediate and unexpected, healer's were retained to treat the failing person. The attention and resources of the dying persons's family were focused around the impending death. Upon death, families and relatives of the deceased came together to mourn . The cremation grounds were located well away from the towns and places day to day activities took place.

For the tribes who lived in the Laguna De Santa Rosa there was life after death. However, the afterlife and the continuation of life for the living was only attainable through rituals performed by the living in behalf of the dead, and by mutually adapting a set of new social relationships, freeing the living and the dead to pursue their seperate existences.

SOCIAL-POLITICAL ORGINIZATION

Chieftanship: Three types of chieftanship were present among the Kamhatara and the Betakamtara: head chiefs, assistant chief, and women chiefs. The office of head chief was most often

inherited with the oldest son preferred successor. However, should there be no sons of the chief to fit the position the chiefs brothers and sons were viewed as the next choice, followed by the sons of the chiefs sister.

A successor was chosen before the death of the current head chief. The successor then became the assistant chief until death. When a successor was chosen the chief presented him to the people. The presentation consisted of talking about the successor's virtues. If the people agreed with the chief the voiced their approval with an "oh". The meaning of a silent assembly was obvious.

At the installation of chief, he was given bead money . With the title chief came many responsibilities; however, chiefs were usually seen to have been person's of influence rather than power. The chiefs duties consisted of advising his people, planning dances, settling arguments, telling newcomers where to hunt and deciding if they could join the village. He also gave moral lectures to children.

Assistant Chief: The responsibilities of this position included giving administrative assistance to the chief, acting as his agent, and acting as the chief in his absence.

Female Chief: She was the leader of the women. She also saw to the preparation of and serving food for special occasions.

Messenger: This position was given to a man who was a fast runner and who spoke more than one language. Messengers served in a diplomatic capacity, carrying invitations to dance festivities, to trade, or to council.

Trading Captain: Another leadership position among the Pomoan tribelets was the trade captain, who planned and arranged for inner-tribelet trade.

Kin Group Leaders

Common among Pomo's each family was headed by a respected man. There was also a leader for the women but the man was the chief leader. These leaders settled minor disputes, kept the families together, and reminded them of the right way to act.

MYTHICAL AND RELIGIOUS ASPECTS

Religion and family life were tightly woven together in the Pomo culture. Though they believed in a creator or God, sometimes personalized by the figure of Coyote, or of Thunder, seen as a great bird with thundering wings and lightning hidden under the wings. Their daily religious life revolved around familiar

spirits of fields or woods. These spirits existed in rocks or trees and other familiar objects or were ghosts that took the form of men, women, animals, or sometimes monsters. Most of them were evil, but to avoid the evil, the Pomo had to carry out certain customs or actions, sing regular daily prayer songs, and not do certain things known as taboos. Fear of these spirits and their actions had added to it fear of being poisoned by enemies even some among their own people.

In any case the Pomo faith in the religion was so strong that it did some very good things for them. It was probably one of the main reasons they washed daily and cleaned up all garbage and sewage. This was because they believed parts of this could be found by their enemy and used to poison them. It also made lies and crimes almost totally unknown, for they feared what would happen to them if they lied or stole. It kept most of the men from chasing other men's wives, and there were very strict taboos against this. It made them keep care of all children with love and kindness. It made them protect the land and wildlife from too much exploitation as evil spirits attacked people who were too greedy about killing game or destroying trees and so forth.

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Byrds, Baylor ; Hawk I'm Your Brother, 1976 MacMillan Publishing Co.

A wonderful story of a little boy who is determined to

learn to fly. Rudy adopts a hawk hoping that their friendship will bring him closer to his goal. A wonderfully illustrated book.

Caduto, Michael J.; Keepers of the Earth, 1988

This book has everything one can imagine to use as a teaching tool. Along with wonderful stories and songs are environmentally aware activities for the children to do. Highly recommended.

Clark, Cora; Pomo Indian Myths and Some of Their Meanings, 1984, Vantage Press Inc. New York.

A great book which accounts for the myths of the Pomo tribes. The author retells legends of the Pomo with retaining the fresh simple style that characterizes folk tales. There is also an extension on each story which explains what the story meant to the Pomo. The children and the teacher both will love this book.

Margolin, Malcom; The Way We Lived 1981, Hey Day Books Berkley, Ca.

A collection of California Indian Reminiscences, stories, and songs. Also Includes the tribe from which the selection came, containing several from the Pomo's. Another must have book.

Purdy, Carl; Indian Baskets and Their Makers; The Mendicino County Historical Society, Reprint.

This book shows all of the Pomo style of baskets along with the techniques used to make them.

Project Aquatic any edition, West Regional Environmental Education Council.

Activities for all ages. A great book for teachers.

Project Learning Tree; any edition, American Forest Council.

Another must have book, with great activities and hands on experience right there at your hand.

Some Social Actions and Instruments of the Pomo.

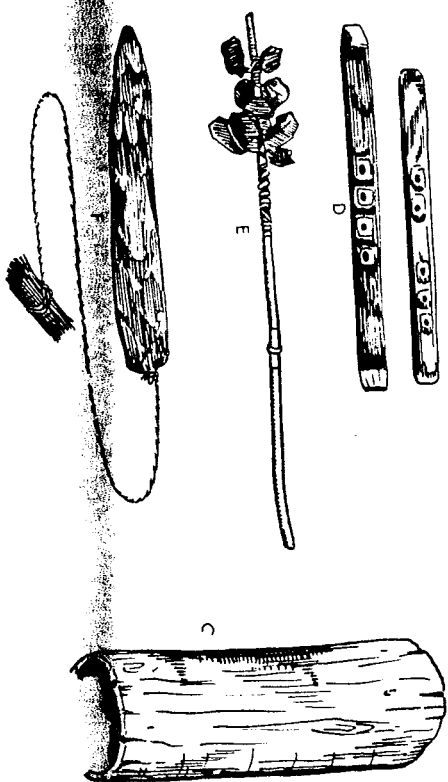
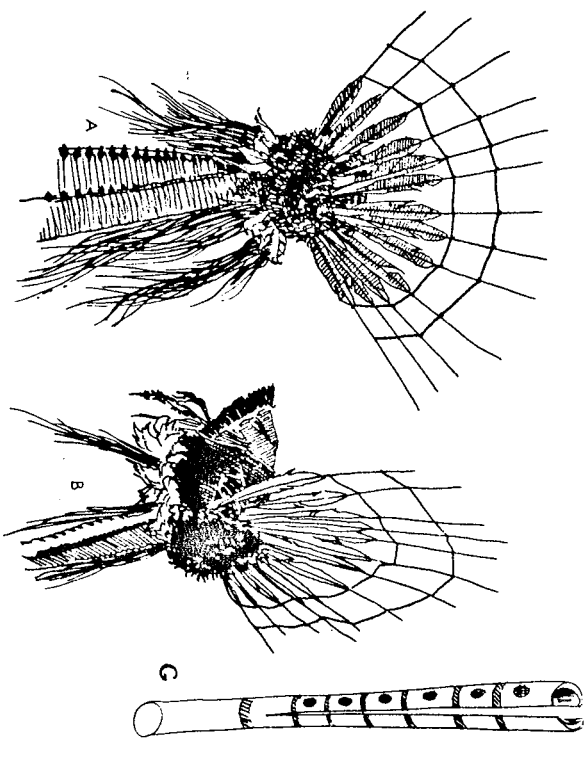
The Pomo had far more social abilities than can be told about here and were a richly-endowed people. Some were:

Musical and musical instruments. In the old days the Pomo were always singing songs of both religious and social significance. The young man usually sang a song to the girl he loved and hoped she would hear it. The mother sang many lullabies to her baby. Men sang songs for hunting, fishing and the like.

Musical instruments included, among others: (1) the flute, made out of an elderberry stick about 10 inches long, with mouth holes at each end and four note holes in four segments in the middle. This was often used by the young man to court his girl; (2) three kinds of whistles, including the one-bone whistle, the two-bone whistle and the large Kaksu whistle, made out of elderberry wood and used in religious ceremonies; (3) two kinds of rattles, one made out of split elder wood (as shown), bound and painted and used as a clapper in dancing, and the other out of 6 cocoons, filled with little pebbles, bound with skin, and hung from a long stick with strings, to be used in dances and in curing by medicine men; (4) the hollow log drum, without any skin over the ends, supported on posts with ropes and tramped on or thumped with a thick stick to make a hollow sound at the dances; and (5) the musical bow, just for amusement.

Money. The Pomo made most of their money out of the Washington Clam, found mainly at Bodega Bay, and so traded for with the Olamnetko. The clam was cut in pieces, drilled for beads and ground round and smooth on stones. The beads were placed on necklace strings of usually 200 beads. Long, cylindrical beads, made from the thickest part of the shell, were the most valuable, worth 20 to 40 times as much. Far more valuable, worth 2000 to 4000 shell beads (or possibly \$5.00 each), were beautiful cylindrical beads made out of cooked magnesite ore (found to the east of Clear Lake). These were not only carefully drilled and shaped, but polished first against stone, and then rubbed in the hands for years to increase their value.

Gambling. There were several different forms of gambling, but the most prevalent was called the Grass Game. Two or more on a side played at this for hours, singing all the time to distract the opponents, a player with special sticks handling and hiding them under a pile of grass, until calling on the opponents to guess where the sticks were hidden. A good guess brought a shout of triumph and an exchange of money, a poor one jeers!



A. Dance headpiece with large tail feathers on top and 2 flicker feather bands, seen from in back; B. same, side view; C. large log drum without covered ends; D. two elderberry flutes; E. rattles made of cocoons and stick; F. bull-roarer, swung around the head to produce roaring noise and frighten and awe women and children at time of night ceremonies; G. elderberry dance clapper.

BASKETRY

Basketry is believed by many scientists to have reached its greatest peak of achievement in America among the Pomo. This speaks highly of their artistic and inventive genius, but sadly of our lack of understanding of their aesthetic ideals, for few Pomo baskets are now made and basket-making of this high quality may be a dying art. Recently some basketry has been shown and classes of the technique held among the Pomo and for some white women in Ukiah and at the Kasha Rancheria near Stewart's Point, but this kind of interest will only flicker and die out unless it is continually encouraged.

The two main types of woven baskets, twined and coiled, are shown in the pictures on page 35. Twined basketry is found among Indian peoples to the north of the Pomo and coiled basketry is far commoner among natives to the south, but the Pomo uniquely combined the two kinds of basketry in an infinite variety of ways and always with superior techniques.

The twined baskets, however, are generally made for rougher usage, such as for holding acorns when they are pounded, back pack baskets and for packing freshly-gathered acorns. But the Pomo did have almost every variety of twining, including lattice twining, checkerwork, and so on.

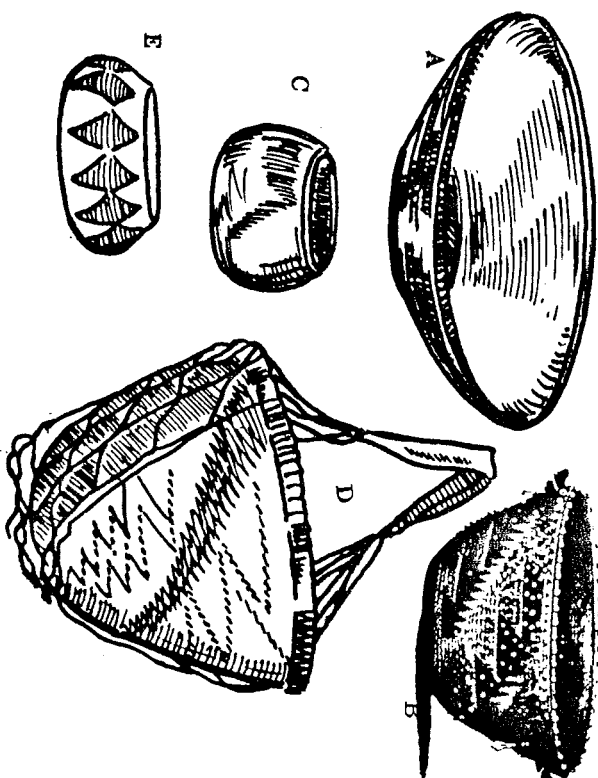
In coiled basketry, they had both single-rod and double-rod coils, and used on both these kinds of baskets many elaborate decorations of brilliantly-colored feathers, beads and shells (as shown in color on the map). So tightly were these baskets often put together that they could hold water without leaking. Red hot stones dropped into such a basket full of meal and water gradually could bring the mixture to a boil and thus cook mush.

The Pomo used as many as twelve different materials for making baskets, but the chief ones were the willow, used universally as the warp in either twined or coiled basketry; while the following four were common as the woof: (1) the root of the sedge (used in both coiled and twined basketry; (2) the bark of the redbud, which furnished a beautiful red pattern; (3) the bulrush root, often dyed black to give a black pattern; and (4) Digger Pine root fibers, which are very strong and good for the woof in twined baskets that were used for rough wear.

All of these materials have become much harder to get since the white people came, as the Indians have been kept out of land where they used to go in the old days to find these things. We can hope that more land-owners will help to renew this fine art.



Pomo basket-maker of Ukiah Rancheria, showing beginning of work on coiled basket. Courtesy Mus. of Anthropology, U. C.



POMO BASKETS: A. Mortar basket for placing on rock grinding basin; B. old picture of feather basket (courtesy Bancroft Library); C. basket cup; D. twined carrying basket; E. water-tight and coiled basket such as used for boiling water.

CLOTHING AND CARRYING EQUIPMENT

The clothing ranged from nothing at all, customary with many men in warm weather, to elaborate dance costumes of skins, reed breast plates, hair nets and brilliantly feathered head-dresses.† The ordinary clothing of the man in cool weather was a blanket of twined and woven rabbit skins, with thrust-through holes for the arms and a rope sash to tie it about the middle if needed. No hat was worn, but, if cold enough, low sewn skin moccasins were put on the feet. Wealthier men and chiefs were inclined to wear seal skin or even sea otter skin blankets. A loin cloth of deer or other skin was occasionally but not often worn or a skin was simply wrapped and tied about the hips. Men usually made the dance costumes for both men and women, of which a typical one is shown in full color on the map. Flicker feathers were used in the head band, which is shown unusually tall in the picture. Such costumes were extremely varied and colorful, decorated with both beads and feathers in many intricate designs, showing talented artistic ability. It is very sad that these magnificent costumes are so rarely seen these days. We should encourage the Pomo to bring back the great dances of old, as they show a unique and beautiful flowering of culture and have rich spiritual meanings.

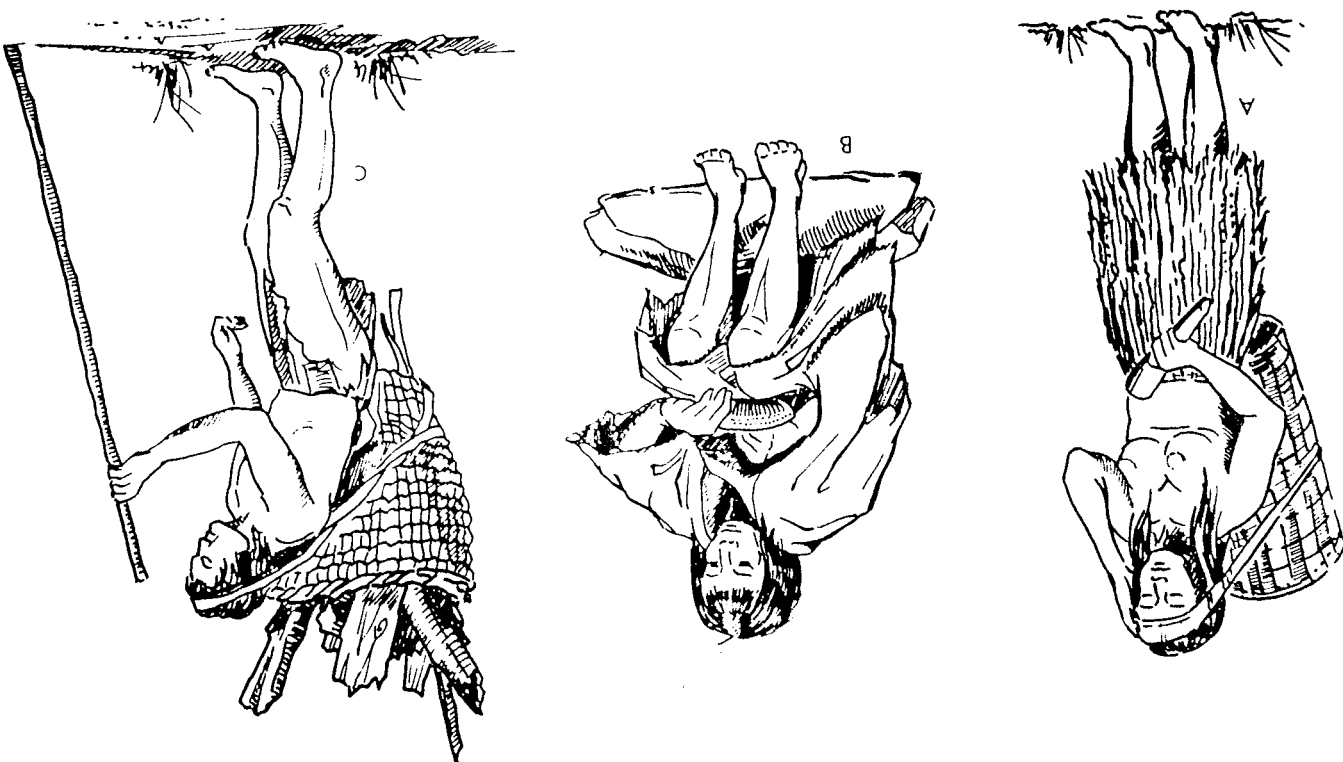
The women wore a two piece skirt of skin or strips of tule or other plant fibers or both plant fibers and skin in combination, with a narrow apron-like part in front and a wider hind section covering clear around the hips.† In younger women some skin was usually raised to cover the breasts. Women usually wore a rabbit-skin blanket around their shoulders in cold weather. A skin skirt often was slit along the bottom for decoration and for greater freedom of movement.

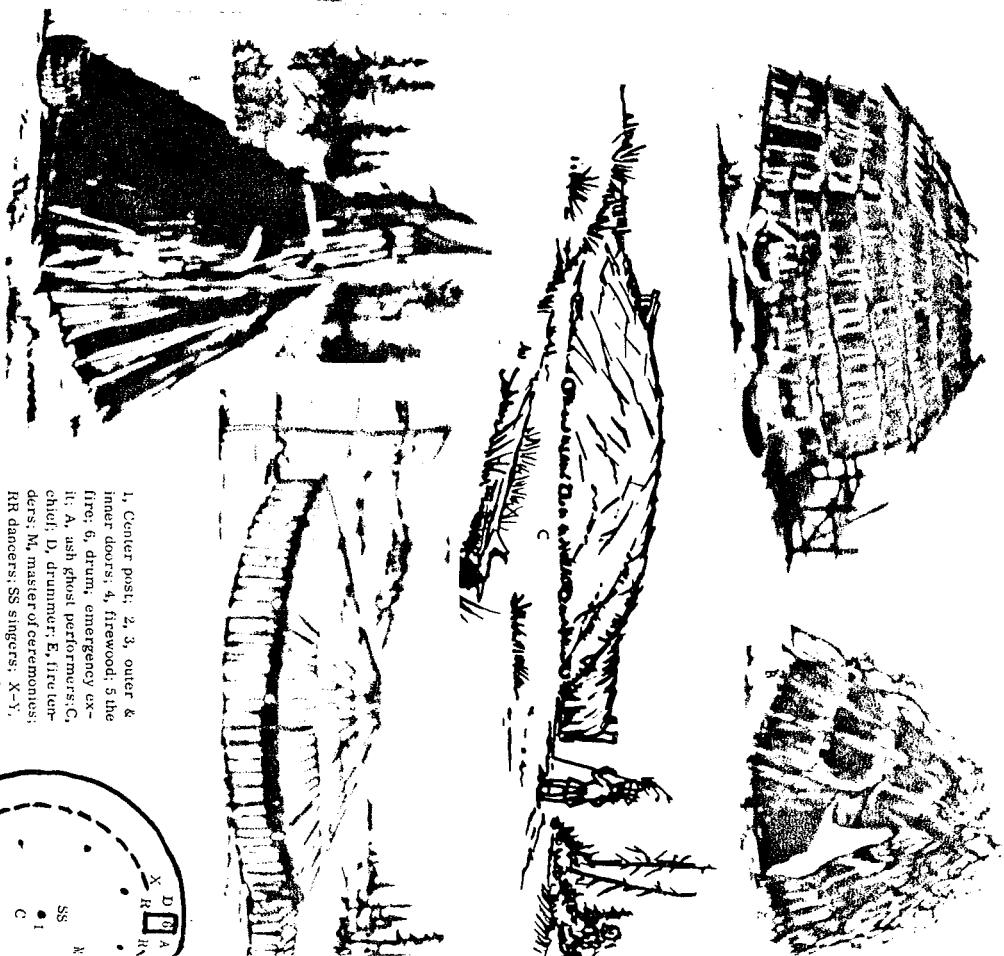
A basket cradle was carried on the back by a mother with a baby. It was a great aid to the mother in allowing her arms to be free to work. Diaper material was usually made out of soft shredded bark. A rabbit-skin blanket was wrapped around the baby to keep it warm in cold weather and it was lashed into place with rawhide thongs. This probably helped develop an erect way of walking and a straight back.

Both men and women used large carrying baskets with head straps to carry things on journeys, but the women did almost all the carrying on lesser trips. It was very remarkable how even old people carried immense loads gracefully and tirelessly.

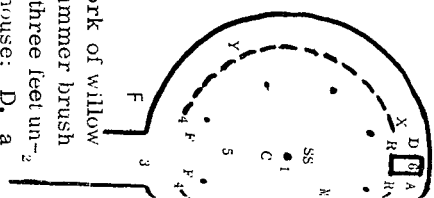
CLOTHING AND CARRYING EQUIPMENT

A. Woman with shredded tule skirt, carrying basket with tump line, and pestle for grinding acorns in hand. B. Man with wood in large carrying basket, wearing loin-cloth.





1, Center post; 2, 3, outer & inner doors; 4, firewood; 5 the fire; 6, drum; emergency exit; A, ash; B, master of ceremonies; C, chief; D, drummer; E, fire tenders; M, master of ceremonies; RR dancers; SS singers; X-Y, visitors; Y-4, home people.



POMO BUILDINGS: A. Family house with framework of willow saplings, thatched with tules and other leaves; B. summer brush hut with skin door; C. dance house with floor about three feet underground; similar in appearance to smaller sweat house; D. a dance house constructed above ground with boards fairly recently; E. Pomo Redwood Tipi; F. diagram of dance house and participants in operation (after Barrett).

HOUSES AND OTHER BUILDINGS

Large and rather comfortable houses were built in the valleys, but the hill people built smaller structures. Permanent dwellings were generally put up along streams for living during winter and spring, while the temporary shelters were put up in hills on treks for food during the drier weather. But hilltops were used for permanent villages in damper forest areas.

Bark tipi. This was generally built by the coastal people who could get thick slabs of bark from the nearby redwood trees with the aid of elk-horn wedges. A central pole, usually with a forked top, was put up, and long willow or other young tree trunks leaned against it. Against this were piled the redwood bark slabs until all holes were covered except a smoke hole in the top and a small doorway down below.

Brush house. This was the common round or oval community dwelling of the valleys, which was sometimes as much as 40-50 feet in diameter. A frame of willows was constructed and curved in toward the central roof hole, the frame then being covered thickly with brush and foliage. Several families had their sleeping quarters around the interior, with a central space reserved for all to cook in. There were usually two doors. The beds were made of mats of grass or tules laid on the ground, or sometimes placed on raised platforms.

Sweat house. This was a smaller, circular house, constructed in a similar way, except a pit a foot or more deep was dug first and dirt piled on top of the brush roof. Only men were usually allowed in this house (except an occasional old woman), in which a fire or red-hot stones were used to start a profuse sweating. In cold weather the men often slept here. Also the sweat house was often used as a club house for discussion of men's affairs.

Dance or Ceremonial House. This was built like the sweat house in a circle, often over a shallow excavation, and with dirt piled on top of the brush roof. But it was usually much larger, sometimes 70 feet wide, with 2 doors, and a smoke hole (see diagram of inside on page 30). Usually the doors were at the beginning of passageways leading into the big room. Leaves and small branches of trees were spread around the outer parts of the circular room for the spectators to sit on. In some areas, especially the north, plants were used in the walls.

Temporary structures. In summer the valley people often moved into the cooler hills, where they lived in temporary lean-tos or under brush shelters made mainly to keep out the sun.

VARIOUS TOOLS AND THEIR USES

The Pomo had numerous tools for daily use, far more than we can picture or describe here. Here are some common ones:

Bones, horns, hard woods and various kinds of rock, but particularly obsidian, were used in the making of tools and the Pomo developed many clever ways to make and use them.

Bone or horn awl. The bone was sharpened by grinding to a sharp point, and fashioned so it could be easily gripped in one hand while puncturing holes in skins or wood, and so forth.

Bone or horn knife. This kind of knife was much more common than the obsidian knife, which was harder to make. The bone or horn could be shaped better by grinding and a good handle fashioned quickly. Used for carving meat, eating, cutting.

Fire drill. In the old days the Pomo twirled a drill to produce fire only by using the hands. The drill was usually made of a straight stick from a wild currant bush, while the wood drilled to produce friction, heat and fire was usually dried buckeye. A handful of mouse nest or other fine dry material was used as tinder, and the first spark was blown into flame. Some Pomo struck two pieces of white quartz together to make sparks.

The arrow straightener. Arrows, after being scraped to proper thickness and dried, were separated into two piles, one of straight and the other of crooked. A crooked arrow was put into a hole previously ground through a flat slab of soap stone about five inches long, which had previously been well-heated in fire. Water dropped on the wood caused it to steam and the fibers relax so the crooked part straightened as it cooled.

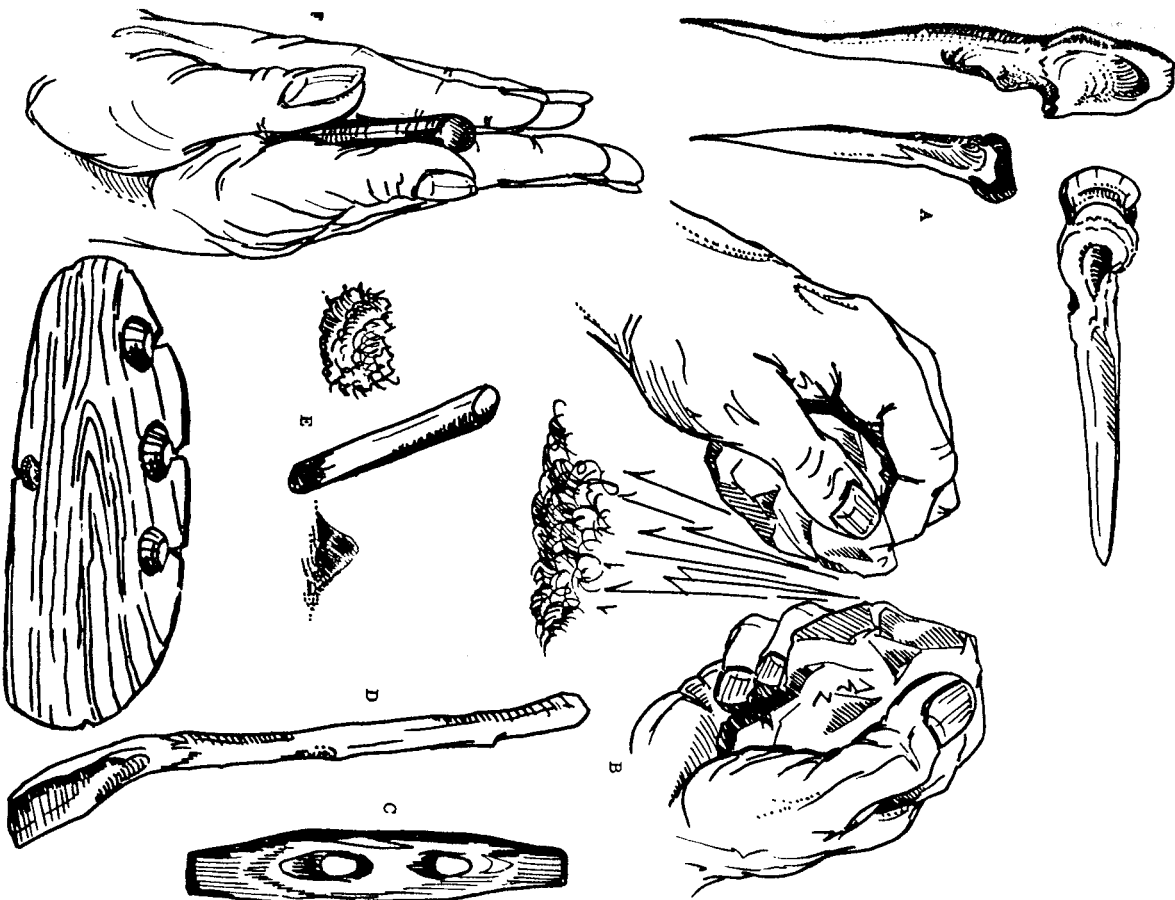
Elk horn wedge. A thick piece of elk horn was ground into a sharp wedge. This was used for splitting wood for firewood or making rough posts out of logs with easily split grain to use in building houses. Wooden slabs for trays were also split out.

Maul stone. This was a stone hammer without a handle.

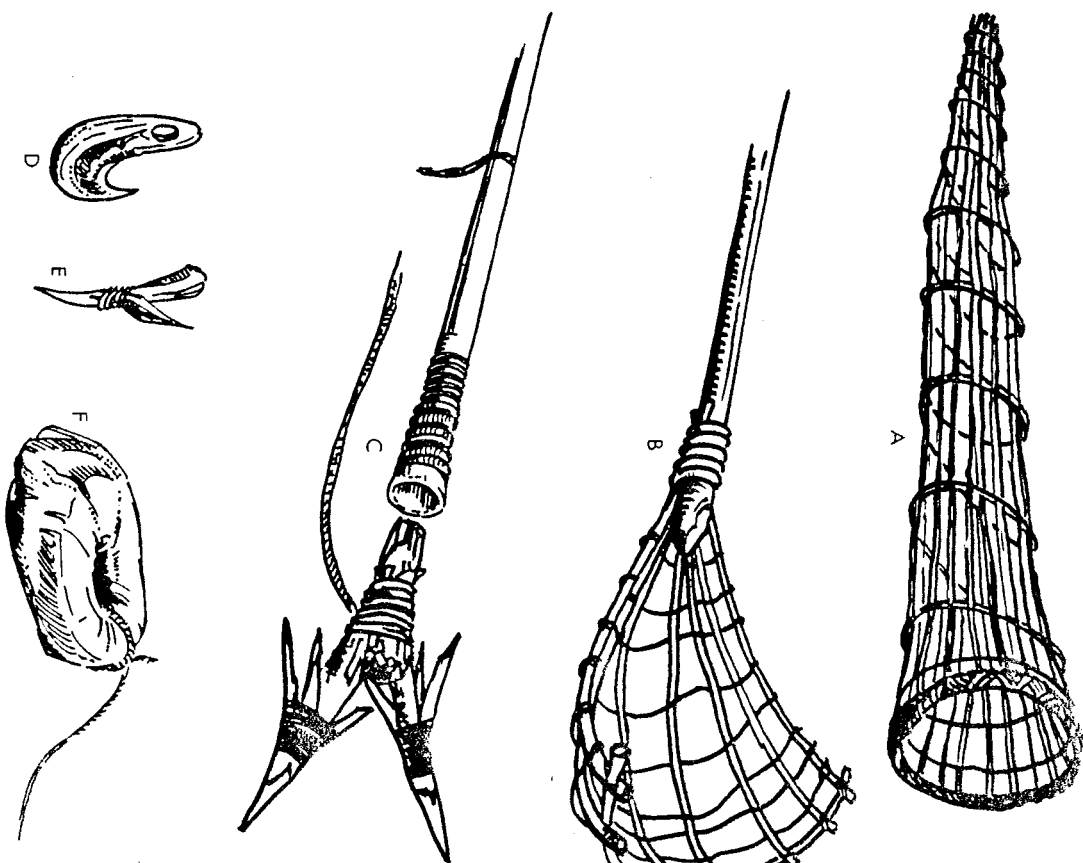
Obsidian flaker of elk horn. This tool had a sharp point which was pressed against a piece of obsidian, as shown, with sufficient sudden force to break off a flake. Much experience, care and patience was needed to produce good stone knives, arrowheads or spearheads. Many were broken before finishing.

Drill with stone point. A small obsidian point was fastened with sinew to a straight piece of hard wood and used for drilling wood, bone, horn, shell or soft soapstone. The drill stick was held between the two hands and twirled back and forth by brisk rubbing while applying as much pressure as possible.

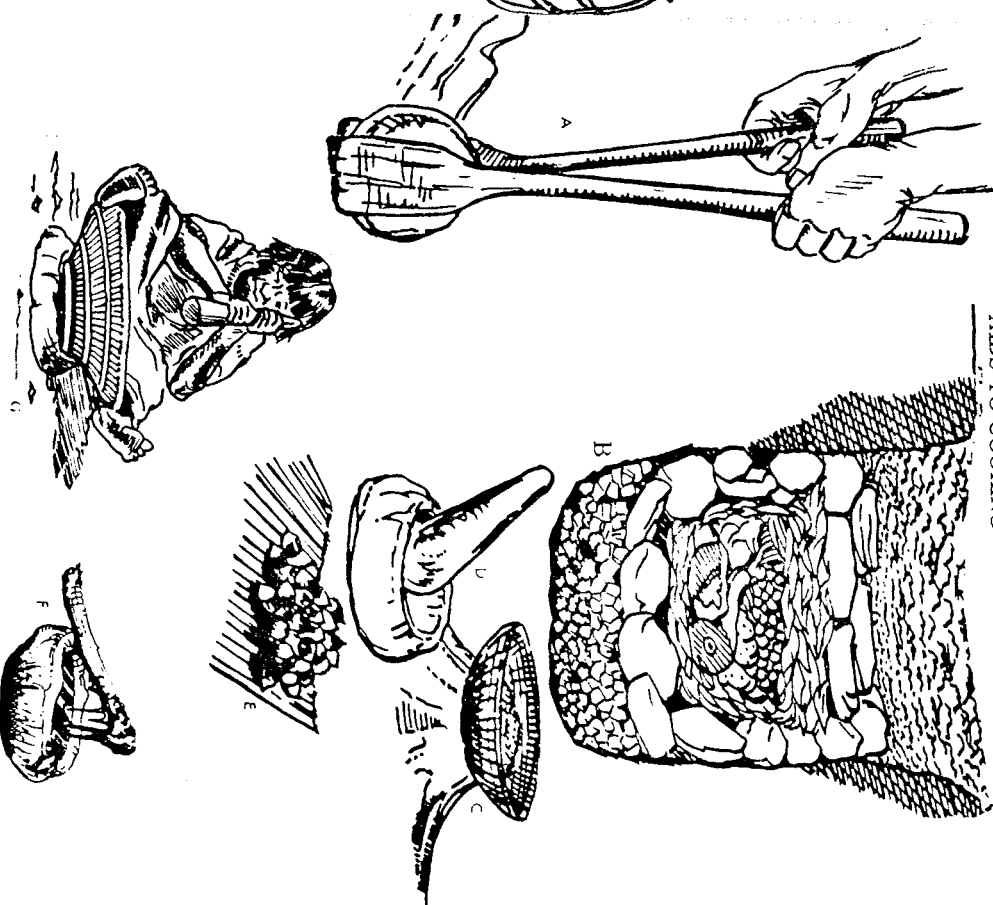
TOOLS



VARIOUS TOOLS: A. bone awl; B. making fire with two quartz stones; C. stone arrow straightener; arrows held in holes after steaming and bent straight; D. stirring spoon; E. fire-making outfit of dried buckeye wood base, ash or pine twirling stick and mouse-nest tinder; F. stick twirled rapidly in hands for friction.



FISHING TOOLS: A. Basket fish trap; fish swims in large end and gets trapped in small end or swims into other basket trap; B. scoop net for scooping fish out of water; C. harpoon with detachable head for spearing large fish; points usually made out of bone; D. curved hook; E. tied hook, made out of bone; F. fish-ling charm.



AIDS TO COOKING: A. 2 long stirring spoons, as occasionally used to place hot rock in water-tight basket to boil water; B. underground oven, using hot rocks and ashes around leaf-wrapped food; C. mortar basket with acorn meal placed in hole in rock to be pounded; D. stone mortar and pestle, often used by old people to grind food finer than usual to assist digestion; E. rush mat with acorns piled on it before grinding; F. soft stone bowl used to hold pitch, etc.; G. Pomo woman grinding acorns with pestle.

FISH, FISHING AND SEA FOODS

While considerable fishing was done by the Pomo along the rivers, such as the Russian and the Gualala, and off the rocks of the ocean shore, this profession reached its greatest complexity and perfection among the Clear Lake Pomo, who extensively used the rafts made out of bound tule (see p. 28), and developed elaborate nets and fish traps. At Clear Lake, also, fishing was more clearly a specialized profession where certain men did nothing but fishing and traded their catch for other things they needed. Often they fished all night when the fish fed.

Fish hooks were used mainly on the lake or on the ocean shore, and were made out of shell or bone. Most stream fishing was done by spearing or by nets or weirs. A weir was made by running two brush and stick fences in the water to a narrow opening where fish could be driven and then caught with the hands. Poisoning was done in still or semi-still water by dropping ground-up soap plant bulbs or buckeye balls into the water, poisonous substances in them stupefying the fish so they could be caught on the surface easily.

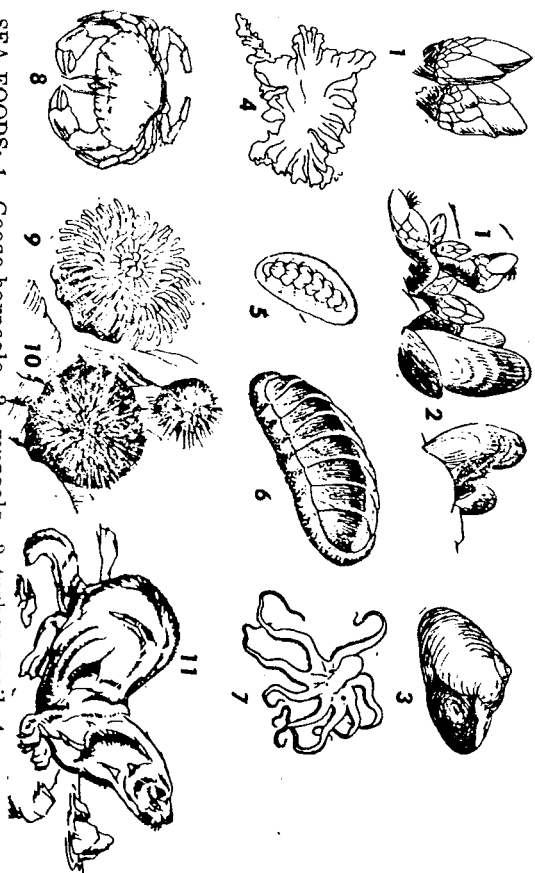
The fish spear was usually three pronged with horn or bone points lashed to the shaft, though sometimes sharp obsidian was used. The harpoon, used mainly at the lake, had two or three prongs, and was made of two parts, the lower with the prongs being detachable, so that a large fish, like a salmon or big steelhead, would carry off the head of the harpoon attached by a cord to the main shaft. (See page 24.)

Seine nets were used by several boatmen on the lake to surround schools of fish. Stretched gill nets were tied to stick posts in the shallows. Smaller gill nets helped land the fish.

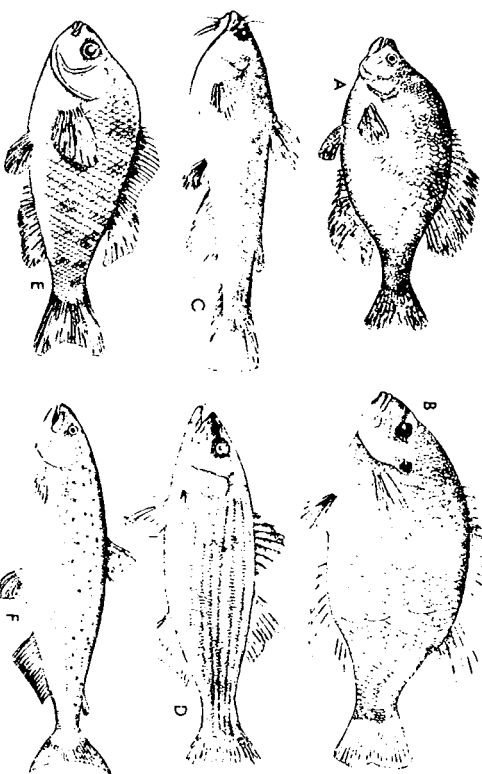
Fish were mainly grilled over fires or baked in the oven. They were also dried and smoked for a reserve food supply.

Ocean fish were caught mainly near the beach with hooks and lines. The octopus was taken with fish poison from its cave or speared in the tide pools. The tentacles only were baked in an earthen oven. Abalone was very popular and was dried raw, then cooked in long strips on hot coals in the earthen oven, or sometimes allowed to soften before cooking or beaten to softness. Chitons were scraped free of inedible parts and baked over coals in the earthen oven. Barnacles were cooked in hot sand that was mixed with red-hot coals. They were also dried, as were chitons, in the sun and stored for the future.

SEA AND FRESH WATER FOODS



SEA FOODS: 1. Goose barnacle, 2. mussels, 3. turban snail, 4. ruffled purple rock weed, 5. lined chiton, 6. mossy chiton, 7. octopus, 8. cancer crab, 9. sea anemone, 10. sea urchins, and 11. sea otter (mainly killed for the warm and beautiful fur).



FISH OF STREAMS AND LAKES: A. White crappie, B. green sunfish, C. square-tailed catfish or brown bullhead, D. striped bass, E. fresh water live bearing perch, F. king salmon.

Brush rabbits, cottontails and jackrabbits (hares) were most often trapped by snares set in their trails among the bushes, speared with sharp sticks, or killed with slings and arrows. Boys would try to surround jackrabbits in practice for the way men would surround deer. Blankets were often made out of twisted rabbit fur and were warm and serviceable.

Squirrels were usually shot out of trees with arrows. Like most small mammals, they were usually crushed before cooking. Boys chased down ground squirrels and killed with sticks.

Wood Rats were flushed by tearing up their nests, chased up bushes and knocked out of them with sticks.

Many birds were hunted and trapped, including especially: Valley and Mountain Quail. These were hunted with blunt

arrows to stun them. A favorite way was to build brush walls in the form of a V, the birds being driven toward the point of the V where a hunter or hunters would be waiting. Quail traps were made out of open-work basketry with a large opening in which the bird entered and a small end where it would become imprisoned. Often the Pomo used quail traps as much as twenty-five feet in length (see picture on page 21). Since quail almost always moved uphill, a trap was set on such a slope, and the Indians very slowly and cautiously drove the birds uphill into it.

Woodpeckers were needed for their bright feathers, used in dance costumes and prize baskets, but were also eaten. They too were trapped in similar round, narrowing basket-work traps put up in trees, or their calls were imitated to attract them and then they were shot with bows and arrows.

The Band-tailed Pigeon and Sooty Grouse were often knocked out of the branches of trees where they slept at night. Most bird meat also was pounded to pieces before cooking in the ovens.

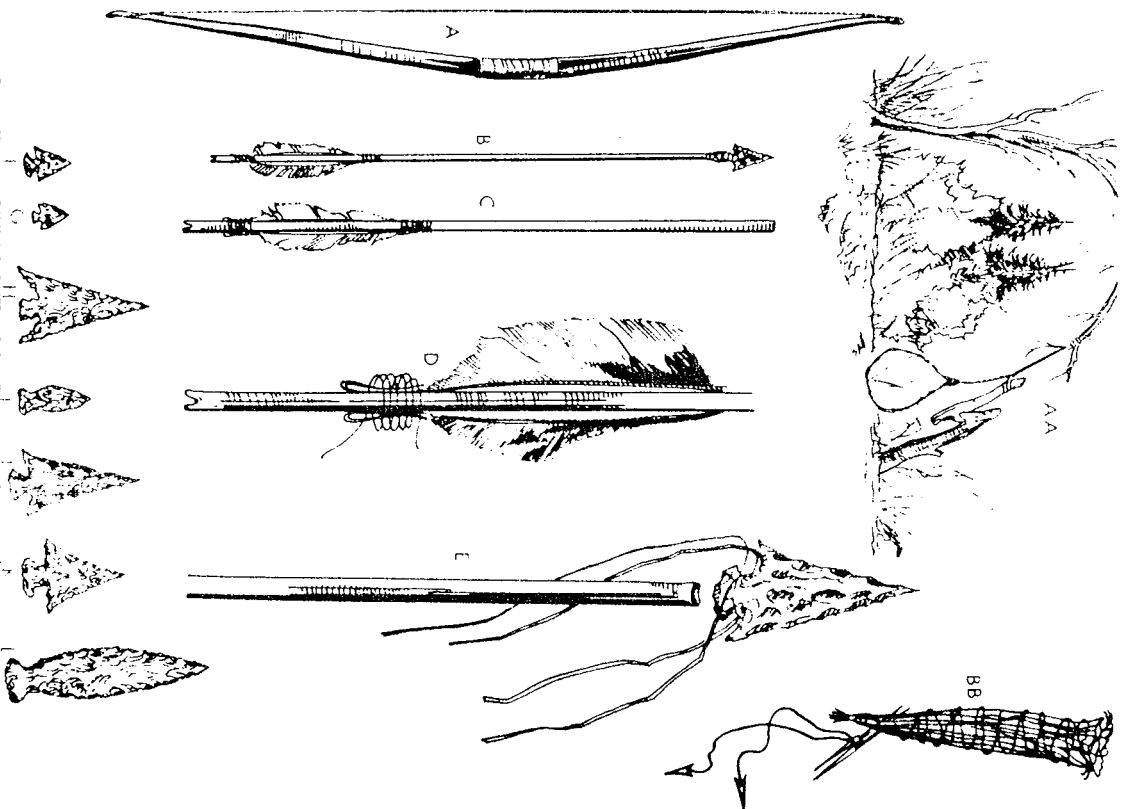
Ducks and wild geese were hunted in the marshes, by the aid of decoys and with bows and arrows, or sometimes trapped in nets when they lighted on the waters. Clear Lake was especially noted for great flocks of them and fine hunting.

Turtles were the most common reptiles eaten, usually being cooked in hot ashes. Small lizards were also eaten.

Grasshoppers were trapped in a ring of fire in dry grass, which also cooked them, then eaten soon after.

TRAPS AND HUNTING WEAPONS

21



TRAPS AND HUNTING WEAPONS: AA. Typical moose snare, BB. trap for quail, placed in trail through brush so quail enters and gets stuck in narrow end; A. sinew-backed bow; B. hunting arrow; C. detail of feathers on shaft; D. same enlarged; E. head of spear ready for attachment; F-L. arrowhead and spear points.

ANIMAL FOOD, HUNTING AND TRAPPING (typical animals hunted are shown on page 19, hunting and trapping equipment are shown on page 21).

Elk were shot with bows and arrows or surrounded by a large ring of hunters and killed with spears. These large animals were hard to kill and took strenuous efforts with much excitement and danger, especially from the bulls or cows with calves. Deer were sometimes surrounded also, but were more often hunted by men who were specially trained and equipped to approach deer, disguised as buck deer wearing head and horns of killed animal (see color picture on map). The deer was approached with great caution, the hunter pretending to act like a feeding deer until near enough to use bow and arrow. Deer were also trapped in nooses strung along deer trails (see p. 21), or in nets. Both nooses and nets were made of very strong plant materials (such as the withes of Virgin's Bower) in order to hold such a large and struggling animal. Both elk and deer meat was smoked over a slow fire in large quantities to preserve it for future use, especially during the winter. The skins of both deer and elk were used in clothing and bedding.

Bears, especially grizzly bears, were rather rarely hunted because of the danger from them. However, some groups of Pomo did hunt bears, especially for the skins, while others avoided them almost entirely. When hunted, bears were either surrounded and speared, or killed by a powerful man with bow and arrow.

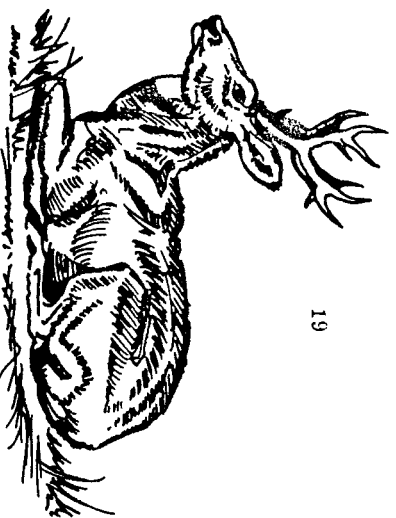
Mountain lions, at least in some areas, were prized for both meat and skins. A good hunter might get one by stalking with bow and arrow. It was difficult to get close enough for a spear.

Sea lions and seals (usually the harbor seal), were either reached by powerful swimmers swimming out to off-shore rocks along the coast, or by men riding log rafts out to the rocks in good weather. Generally these animals were killed by clubbing them to death, and the bodies then dragged by ropes behind the swimmers or the rafts back to the land where they were skinned and the meat cut up for cooking.

Sea otters were prized for their fine fur on some parts of the coast and ignored on others. Usually only chiefs were rich enough to buy such furs, which might be used as a badge of rank. These animals also were clubbed to death on the rocks or were harpooned with harpoons having detachable heads. (See p. 24.)



American Elk



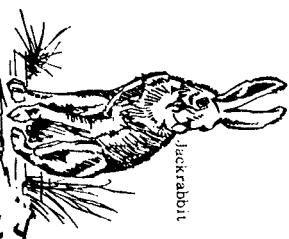
Black-tailed Deer



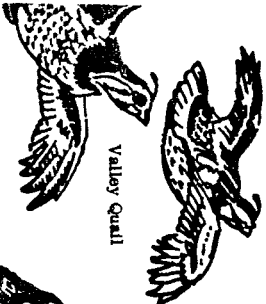
Raccoon



Black Bear



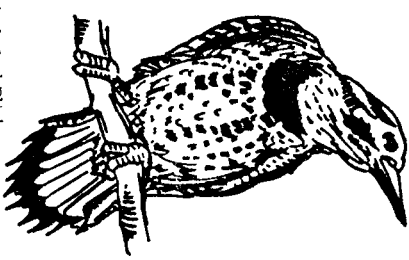
Jackrabbit



Valley Quail



Band-tailed Pigeon



Red-shafted Flicker



Canadian Goose



COMMON ANIMALS AND BIRDS EATEN BY POMO.

T. J. ANDREWS

Bulbs of the soap plant were used both as soap and a fish poison, the pounded bulbs being thrown into calm water to stupefy the fish for easy catching. But some of the interior Pomo baked the bulb to eat like a potato. Bulbs of the Brodiaea or Blue Dicks were eaten either raw or roasted.

Berries of some of the manzanitas were pulverized and mixed with water to eat or sometimes mixed with other foods for flavor. Lake Pomo made the berries into a drink. Toyon berries were heated in hot ashes and then eaten, but berries of the huckleberry, wild grape, western raspberry, wild strawberry, also the thimbleberry, etc., were eaten raw.

Ferns. Young curled tops of the bracken ferns were eaten raw, but also roasted for a day and night in hot ashes and then boiled. The root stocks were also boiled and eaten.

Tubers of the Arrowhead or Tule Potato were dug up in the marshes and either roasted or boiled, some being preserved after roasting for winter use.

Roots and Rootstocks. Rootstocks of the Yellow Pond Lily were dug up and baked, the seeds being used for bread or soup. The Squawroot or Yampah has roots that were gathered in spring, washed, trampled, then washed again, and cooked as potatoes are. One kind was boiled until mealy, peeled and cooked as a soup. Cowparsnip roots were cooked like rutabaga.

Leaves of such plants as Miner's Lettuce, early spring Cowparsnip, and some clovers, etc. were eaten raw. Others, such as the leaves of some lupines, Hedge Mustard, goosefoots, etc., were boiled in baskets with hot stones and water like spinach.

Flowers of some plants, such as clovers, mallows, etc. were eaten raw.

Sugar was made by cutting bark of Sugar Pine and gathering the sweet sap when it solidified.

Salt was usually obtained from seaweed on the coast, or from salticks in the interior.

Seaweed of several species was dried on rocks and then taken home to be stored and then cooked later in earth ovens, then made into cakes. Sea Palms were cooked in hot ashes or on a flat rock. Kelp was also cooked in hot ashes.

Gum was made from pine pitch.

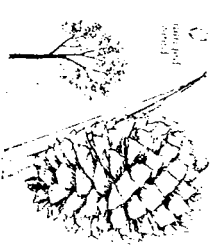
Many other plants were used, not only for food, but also for medicine, but this will give some idea of the variety.

EDIBLE PLANTS

17



Bracken Fern



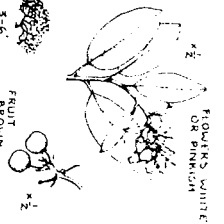
Digger Pine



Arrowroot (tule potato)



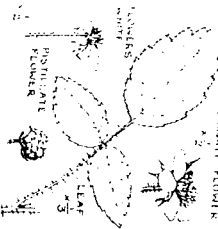
Coast Live Oak



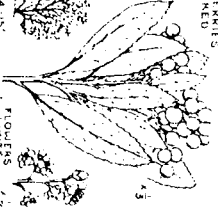
Hoary Manzanita



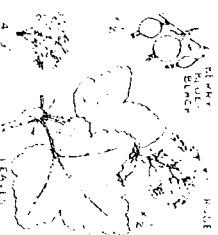
California Bay



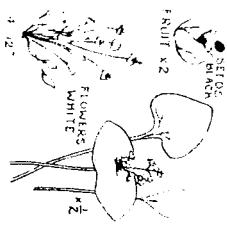
Wild Blackberry



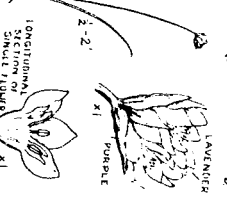
Toyon Berry



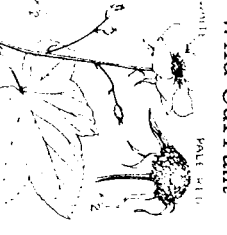
Wild Currant



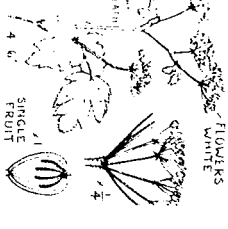
Miner's Lettuce



Blue Dicks



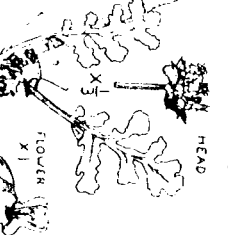
Thimbleberry



Cow Parsnip



Hedge Mustard



Chia

NATIVE AMERICAN STUDIES PROJECT

LESSON PLAN THEME BIG TIME

GRADE LEVEL K-12

SUBJECT CONTENT California Indian Trading Game

CONTENT AREA: Art/Crafts

SEQUENCE NO. 4 of 4

Geography

History
Lang. Arts
Math

Physical Ed.
Psycho-Motor
Reading

Science

OBJECTIVE Students will construct/play a trading game with 80% accuracy which is based on the concept of

trading activity among California Indians.

ACTIVITIES

EVALUATION

MATERIALS NEEDED

1. Mount and color trading game board (from Sierra Media Systems, page 92 & 93).

12x18 construction paper

2. Select trade items

3. Play game

Trading items: either real thing or made of pottery

TRADE ROUTES—

A study of the trade routes of prehistoric Californians have revealed many interesting facts about the exchange of goods and the spread of culture. Some artifacts traveled from group to group over great distances. Marine shell beads were found in Pueblo sites and Pueblo pottery, war clubs, twined bags, and woven cloth were found along the Pacific Coast and off shore islands. Mexican stone-ware was found in historic Luiseno villages and dentalium shells from around Vancouver Island were traded northward to Alaska and southward to the Chumash.



HOPE VALLEY

As a rule, territorial rights were carefully observed since trespass was cause for war. Only the Mohave in the south and the Modocs in the north were fierce enough to travel where they wanted virtually unmolested. The usual procedure was direct trade between groups sharing a common border. The trade goods might later be traded to another neighbor with an increase in "price." But tolls were not paid to transport goods from one neighbor to another.

Any restriction of trade could be attributed to hostility between neighboring tribes, adverse weather conditions, or geographical barriers. The Washo and Maidu, although neighbors, had little social or trading contact because of the crest of the Sierra Mountains. Yet the Tubatulabal and Southern Yokuts, the Northeastern Pomo and the Yuki, the Tolowa and the Karok were on very friendly terms and visited frequently, exchanging goods, ideas and customs.

On the other hand, the Pueblo Indians from Arizona and Nevada were allowed to work the turquoise mines in the Mohave Desert. They often stayed for an extended period while gathering turquoise.

The native trails, originally game trails in some instances, were later developed into military roads, emigrant trails, freight routes and public roads. Most of Santa Fe Railroad and Highway Rt 66 followed an aboriginal route. This was a reasonable expectation because explorers and other early travelers were either guided or given directions by the natives. In wooded areas the trails closely followed streams and rivers. This was the custom of the Valley Misenan (Southern Maidu). In more open mountain areas, the trails followed the ridges of the mountains, but were slightly below the crest. Even if a river were being followed, the native would follow it along the ridges, rather than on the canyon floor. Conversely, Miwok trails were arrow straight, running up and down hills without deviation. Finally, what is referred to as a trail in research literature is often actually a main trail and another (or two) parallel trails.

The Yurok marked their trails by shooting arrows into certain trees, or dropping twigs or stones at the junction of trails. Soon a pile of brush would accumulate, which white men took to be shrines and called them such. Actual shrines containing bits of pots, beads and other artifacts offered by traveling natives were found in Yurok, Chilulu, Wiyot, and Wappo territories. The Serrano and Yana groups marked their trails with piles of rocks. The pictographs found in Chumash territory may have marked the origin of trails.

In other parts of North America, Indians most frequently exchanged shell beads and animal hides, but in California food and tobacco were traded most often. Other common trade items (in descending order) were beads and shell products, manufactured goods, all kinds of raw materials, clothing and textiles, feathers and birds, and miscellaneous items. Surprisingly, salt was the single most frequently traded item. Dentalium and clam shell beads were valued treasures and served the same purpose as our money. Of course, the value of any item depended on its desirability, availability and whatever trade could be agreed upon by the interested parties.

TRADE ROUTE GAME

Directions for Preparation:

1. Cut out map, color it, and glue it to cardboard or hardboard.
2. Trade List: salt, obsidian arrow point, clam shell, fish, acorns, pinenuts, feathers, string of beads, pottery, deer horn, boat, rabbit, rope, fire making tools (and others you can think of).
3. Get one die.
4. Play the game in groups of five (or four). The winner of each game will then play the other winners to become the Best Trader.

Rules for Play:

1. Each player must visit the village of every other player and return home first with goods to win.
2. Use a trade item for marker. If player loses all trade items, including marker, that player is out of the game.
3. Player must trade at every village before moving on.
4. Lucky number 6 gets player to next village or overcomes obstacle.
5. After third roll of die, if a six has not been thrown and a trade has not been made, the stranded player will forfeit trade item on spot and move on.
6. First player that comes to an obstacle with a trade item by the trail may take the trade item if the player moves on without making a forfeit.

TRADE ROUTE GAME

Directions for Preparation:

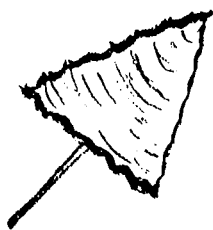
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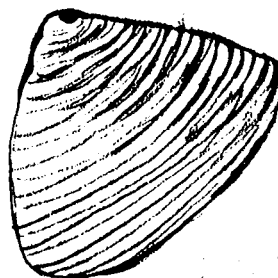
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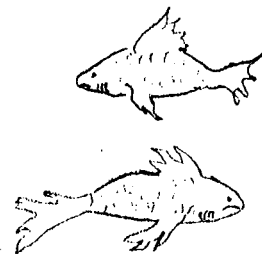
Salt



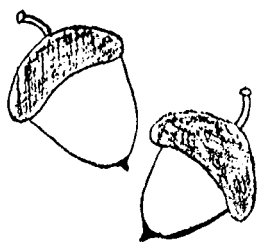
aboriginal arrow point



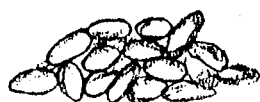
Clam shell



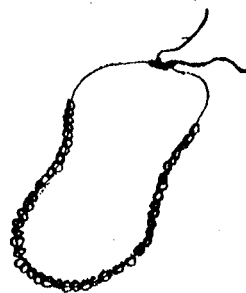
fish



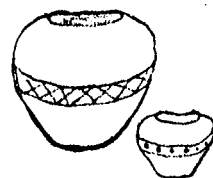
acorn



pebbles



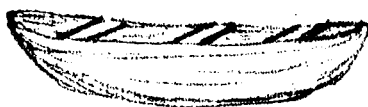
string of Beads



pottery



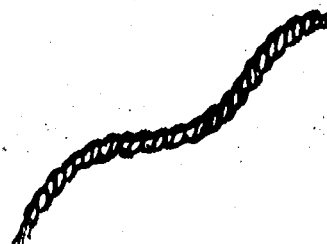
Deer horn



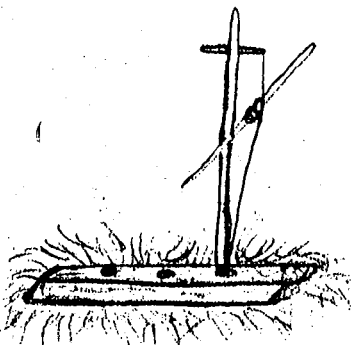
boat



rabbit

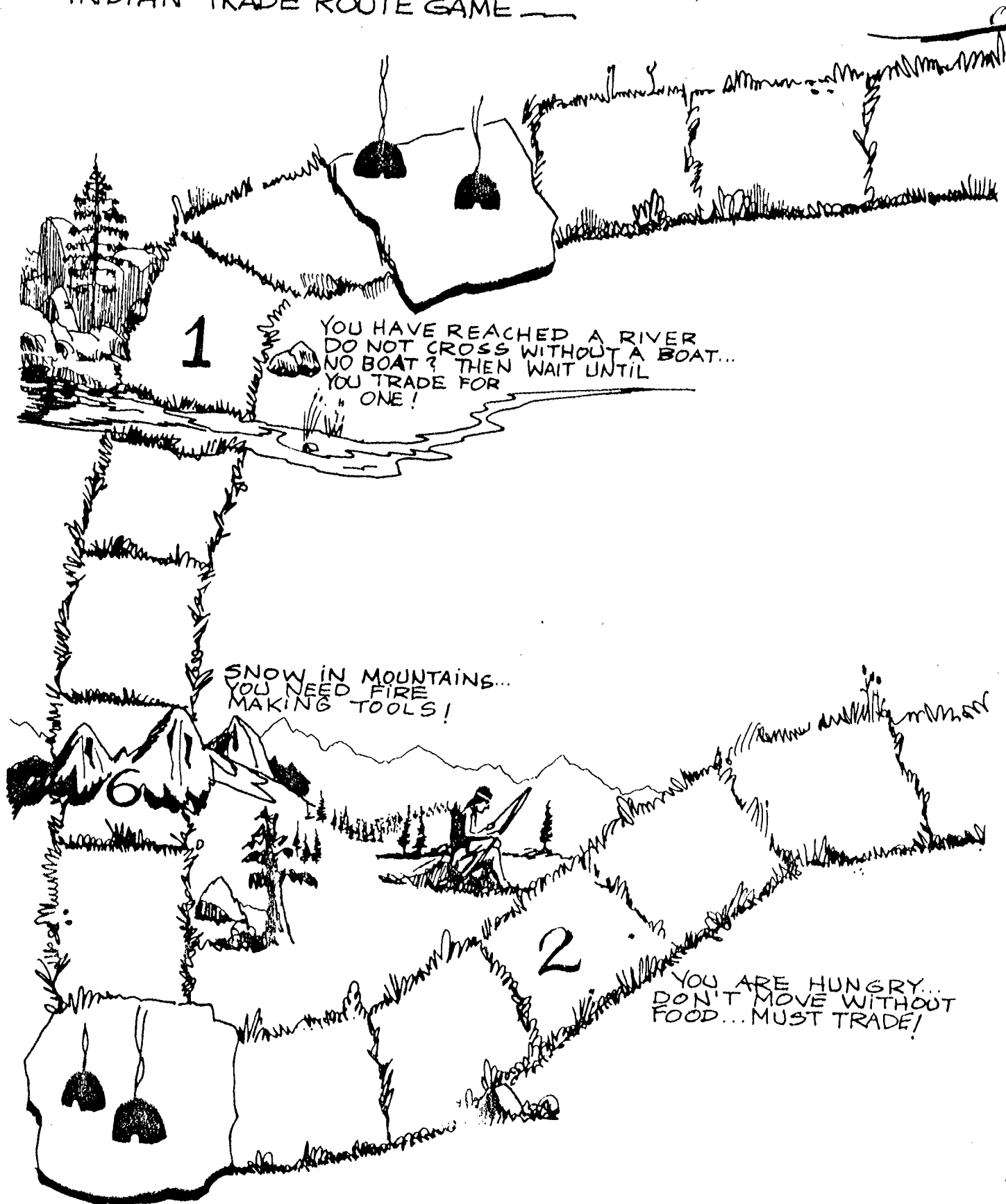


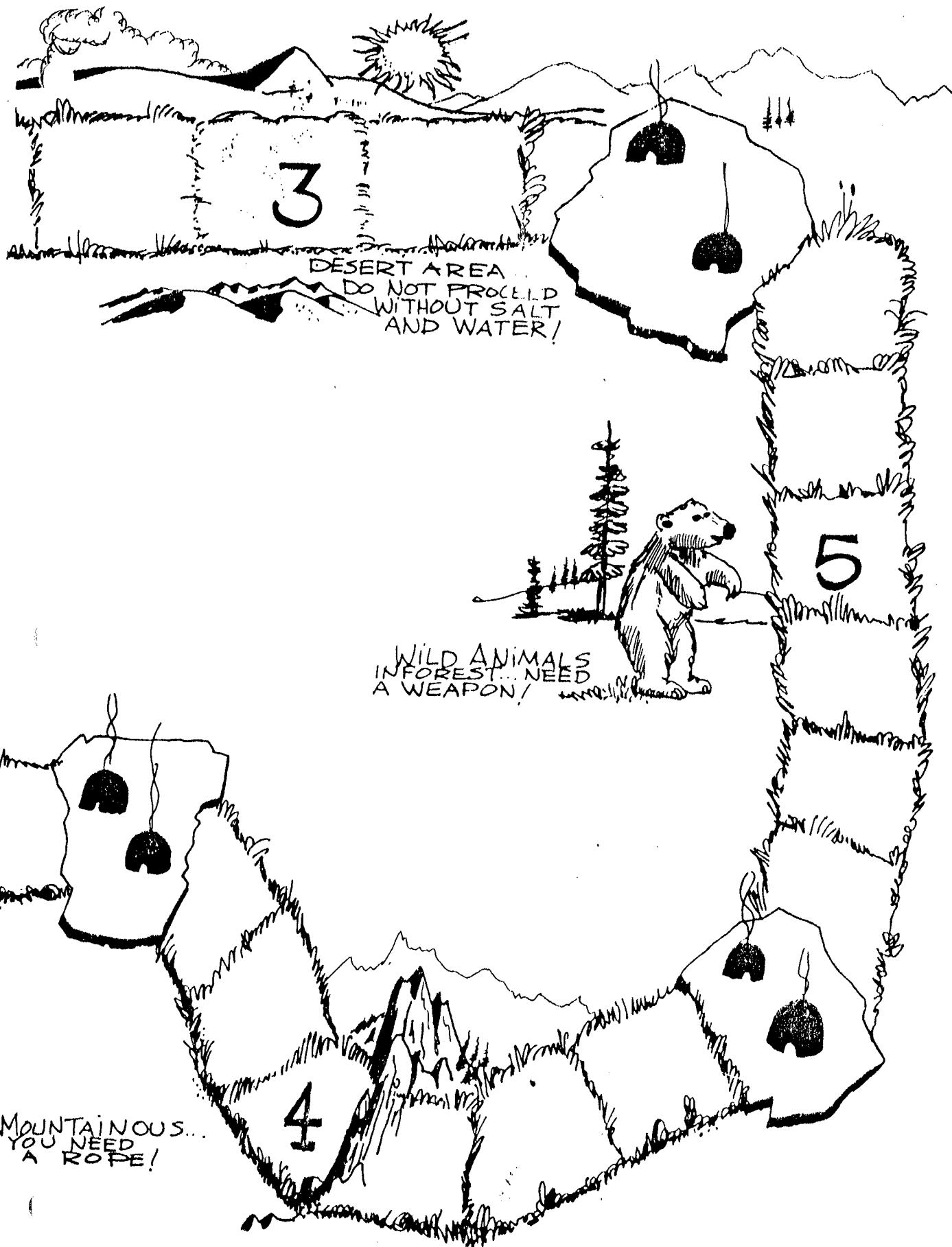
rope



OBSTACLE MAP

INDIAN TRADE ROUTE GAME





3

DESERT AREA
DO NOT PROCEED
WITHOUT SALT
AND WATER!

5

WILD ANIMALS
IN FOREST... NEED
A WEAPON!

4

MOUNTAINOUS...
YOU NEED
A ROPE!

NATIVE AMERICAN STUDIES PROJECT

LESSON PLAN THEME BIG TIME

GRADE LEVEL K-12

SUBJECT CONTENT California Indians Crafts

CONTENT AREA:

Art/Crafts
Geography
Health

History
Lang. Arts
Math

Physical Ed.
Psycho-Motor
Reading

SEQUENCE NO. 2 of 4

PREPARED BY/DATE G. Parker, 3/84

OBJECTIVE

Students will demonstrate skill in making a carrying net using California Indian basket/net making skills with 80% accuracy.

ACTIVITIES

EVALUATION

MATERIALS NEEDED

Construct carrying net following attached directions (from Sierra Media Systems, page 63).

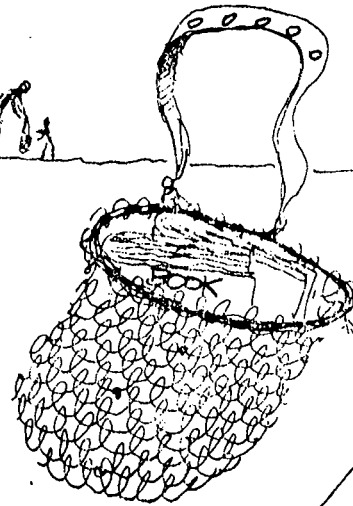
Finished project

Cloth bands
Coat hangers
Macrame jig

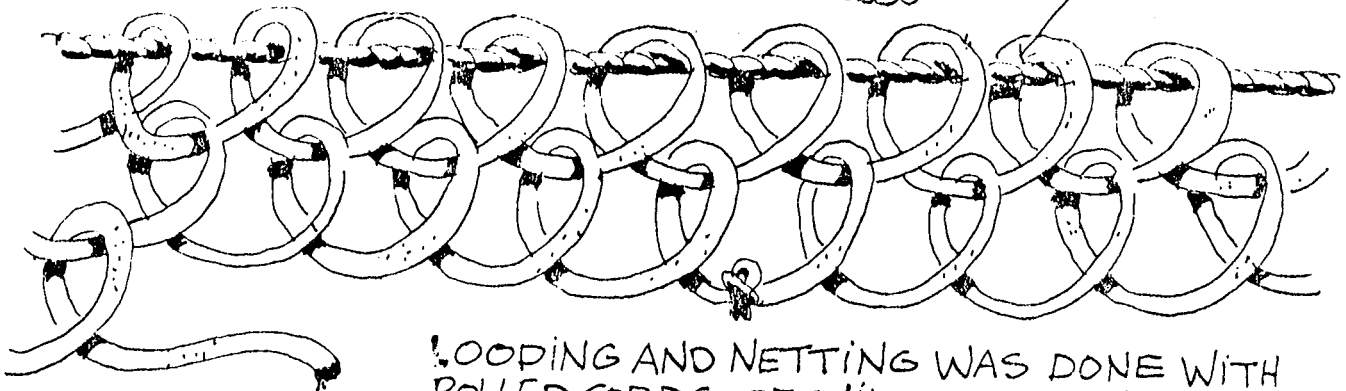
MAKING A CARRYING NET TO USE

THESE NETS WERE "STRETCHABLE BAGS" THAT COULD BE CARRIED ON THE BACK...IN HAND...OR ON SHOULDERS~

BAND CAN BE SOLID CLOTH, OR CONSTRUCTED OF MACRAMÉ MATERIALS~

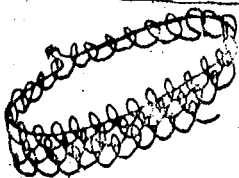


TOP LOOP MADE OF HEAVY CORD



! LOOPING AND NETTING WAS DONE WITH ROLLED CORDS OF WILD HEMP, IRIS FIBER * OR MILK WOOD. THE LOOSE "LOOPING" GIVES THE DESIRED "STRETCHING"~ QUALITY FOR CARRYING BULKY CARGO.

MATERIALS NEEDED : COATHANGER WIRE FOR INITIAL WORKING JIG ...MACRAMÉ FIBERS ~



USE COATHANGER TO SET OPENING OF NET. AFTER NET IS COMPLETED...REMOVE WIRE AND INSERT TOP LOOP~

~ THEN ATTACH HEAD BAND BY KNOTTING IT TO ONE SIDE OF NET OPENING.

* OR MILKWEED

NATIVE AMERICAN STUDIES PROJECT

LESSON PLAN THEME BIG TIME

GRADE LEVEL 4-12

SUBJECT CONTENT California Indians

CONTENT AREA: Art/Crafts

Geography

Health

History

Lang. Arts

Math

Physical Ed.

Psycho-Motor

Reading

Science

SEQUENCE NO. 1 of 4

PREPARED BY/DATE G. Parker, 3/84

OBJECTIVE Students will demonstrate reading comprehension of California Indian information by completing teacher-

prepared worksheet and coloring sheet with 80% accuracy.

ACTIVITIES	EVALUATION	MATERIALS NEEDED
1. Jigsaw puzzle discussion of California Indian paragraphs.	Worksheet completion	Puzzle paragraphs
2. Paragraph worksheet		Classroom copies of teacher worksheets and coloring worksheets
3. Coloring worksheet from Sierra Media Systems, page 36		
4. View Basket filmstrip from N.I.C.E. curriculum		Filmstrip/projector

ONE

The Indians of California are different from the other Indian people we have discussed. They built different styles of houses, hunted and fished for different foods and had differing religions. Their clothing also varied--all these variations existed because of the differing environments where the Indian people lived.

TWO

There are two things that the Indian people of California had in common: they were not farmers and did not make pottery. They did not farm in the past because they depended on the acorns from the oak tree as a primary food source. Acorn meal is very nutritious and is used to make bread, mush or soup. Families or groups of relatives collected acorns from "their" oak trees year after year.

THREE

California Indians, in the past, were not pottery makers. Instead, they made beautiful utilitarian basketry. The baskets were used to carry things, store things, cook, hold babies, or just about anything else you can imagine. Baskets were also made for art--some of them are so small you need a magnifying glass to see them. The baskets were also finely woven with a feather cover for wedding gifts. Some baskets are worth thousands of dollars today. People buy them because they are also beautiful art objects.

FOUR

Most of the Indian people of California moved several times a year. They had permanent, well constructed winter villages. But, in the late spring and early summer they might move in family groups to begin gathering all the wonderful plants they ate and used to make baskets. They also hunted and fished during their summer and fall jaunts. While they were moving around, they built temporary housing.

FIVE

Every year before the Indian people of California would leave their winter villages, they would have a celebration called a "Big Time" by some tribes. All the new plants growing because it was spring would be collected and cooked into mouth-watering dishes. The acorns left from winter storage would be cooked and the men would bring in deer and fish. It was a great party. Some California Indians had their big time in the fall after all the foods had been collected and these were great parties, too.

SIX

The California Indian "Big Time" or party was also a time for religious ceremonies in the roundhouses (or churches), trading all the nice items made during winter such as: baskets, shell beads, bows, arrows, dance rattles and clapper sticks, abalone jewelry and many other things. Trading all these things within the village and from village to village was a banking system for the people. Salt from the coastal tribes might be traded for acorns from the foothill Indian people.

SEVEN

Today many of our highways and freeways are built right over the trade routes that the California Indian people traveled up and down the state. There have even been shells and shell jewelry found in Nevada, Arizona and New Mexico archaeological sites hundreds of miles from the Pacific Coast. The land of California in the past was in someways much like it is today. There were many ways of life among the Indian people who loved California because it has moderate climate, lots of food and fun.

NAME _____

CALIFORNIA CULTURAL AREA (4-12)

Fill in the best answer:

1. The _____ was the main source of food in California.
2. Acorn meal can be made into mush and _____.
3. The large village roundhouse was used for _____ purposes.
4. Some baskets are so _____ that you need a magnifying glass to see them.
5. A "Big Time" is like a _____.

Circle the best answer:

1. There are few/many different ways of life among California Indians.
2. Indian people of California lived in temporary/permanent summer homes.
3. Today, many freeways/swimming pools are built over old California Indian trade routes.
4. The climate of California is harsh/moderate.

Answer True or change the underlined part of the statement to make the statement true:

- _____ 1. The California Indians did develop agriculture.
- _____ 2. The California Indians made many different kinds of pottery.
- _____ 3. California Indians traded items over short distances.
- _____ 4. Baskets are utilitarian objects.
- _____ 5. Acorns were a secondary food source for California Indians.

Vocabulary Words:

jaunt _____

primary food source _____

nutritious _____

utilitarian _____

moderate _____

NAME _____

CALIFORNIA CULTURAL AREA (4-12)

"Key Sheet"

Fill in the best answer:

1. The Acorn was the main source of food in California.
2. Acorn meal can be made into mush and bread/soup.
3. The large village roundhouse was used for Ceremonial purposes.
4. Some baskets are so small that you need a magnifying glass to see them.
5. A "Big Time" is like a party.

Circle the best answer:

1. There are few/many different ways of life among California Indians.
2. Indian people of California lived in temporary/permanent summer homes.
3. Today, many/freeways/swimming pools are built over old California Indian trade routes.
4. The climate of California is harsh/moderate.

Answer True or change the underlined part of the statement to make the statement true:

- did not 1. The California Indians did develop agriculture.
- baskets 2. The California Indians made many different kinds of pottery.
- long/t 3. California Indians traded items over short distances.
- True/art 4. Baskets are utilitarian objects.
- Primary 5. Acorns were a secondary food source for California Indians.

Vocabulary Words:

jaunt _____

primary food source _____

nutritious _____

utilitarian _____

moderate _____

Period -

CALIFORNIA CULTURAL AREA HOMEWORK ASSIGNMENT



meaning to California Indians of long ago:

NAME

Class

Period

Date

CALIFORNIA CULTURAL AREA HOMEWORK ASSIGNMENT

"Key Sheet"



Activities

Once Upon a Place

ACTIVITY: Visit a special place in a natural area several times, using activities to increase sensory and intellectual awareness of those surroundings. Keep a record of these visits, using a journal or other medium, and share the experience with others.

GOALS: Appreciate that stories are an important way for us to enjoy and understand the world around us. Develop a sense of place, a relationship with a natural



Figure 3-1. A meaningful relationship with the Earth begins with the positive experiences associated with a special place outdoors.

area. Enhance sensory awareness skills. Understand the importance of giving and receiving.

AGE: Younger Children and Older Children

PROCEDURE: Find a natural area that the children can visit periodically, such as a woodland, field, pond or park. Ponds, lakes, streams and wetlands work especially well because they often teem with life. During the first visit the children will each pick a special spot in that environment. It should be a place in which they enjoy sitting and exploring and one which makes them feel safe. Have the children go to their spots and sit quietly for about five to ten minutes the first time. A short visit is recommended initially because it takes time for them to get used to sitting quietly, and it often takes a few trips before their places take on special meaning. Gather the

group together and have each child share one experience from her or his place.

For each subsequent visit have the children bring a gift to their places. This gift should be something simple from nature, such as a leaf, acorn or some soil. Also, have them record their discoveries with words or pictures in a journal, or by making models out of clay or other media. Here are some activities for them to do at their places:

- Become an ant. Lie on your stomach with your eyes close to the ground and imagine you are an ant walking along the soil. What does it look like? Feel like? Smell like? Do you hear any strange sounds? Use your hand lens to look more closely to get an ant's-eye view. Draw a picture or write a short description to say what it is like being an ant.
- Sit upright and do not move. Pretend that you are part of the nature around you. If you must move, do so very slowly. You may find that insects or other animals come close to you.
- Choose one plant growing at your place and look at it carefully. You could choose a large tree or a blade of grass. Get to know it by using your senses.
- Write a poem or draw a picture on a rock. Then place the rock with the poem or picture face down as a gift to the Earth. Or do the same thing on a leaf, stick or piece of bark. Put the leaf, stick or bark poem under a rock or log and, during the course of your return visits, watch your gift slowly decay over time as it is received by the Earth.
- Lie on your back and close your eyes for the entire visit to your place. Live in the world of sound without using your sight.
- Walk around your place and look for litter from people's visits; clean it up if necessary.

After several visits, when the children have become familiar with their places, direct the older children in more challenging activities such as learning the names of some of the plants that grow there and their natural history—for instance, how and why the plants grow where they do, set seeds and form spores.

Have the children share their highlights with each other after each visit. Reinforce the idea that the gifts they receive from their places are the experiences and memories that they bring away from those spots and the things they have collected. These gifts can be included in their journals. Have them visit at different times of the day and under varying weather conditions to provide a variety of experiences. Take a picture of each child in her or his place at least once during these visits.

If safety allows, visit the site on a starry night. The birds of daytime will be replaced by the less-known

creatures of the night world: bats, owls, nighthawks and more. Everything will sound, smell and appear different than during the day.

When the outdoor visits are over, have the children create stories from their "Once Upon a Place" collections and memories. Young children may have pictures and objects that can be shared with others. Encourage older children to write a story, puppet show, play, song or report about their place. Be sure they tell what they brought to the place and what they received from it.

MATERIALS: Natural area (preferably where it is quiet); pencils; paper; clay; paints and brushes; water; crayons; field guides to plants, animals, rocks, etc.; hand lenses;

one collecting box for each child (shoe-box size will do); camera and film; cardboard backing to write against; bags for litter cleanup; journals.

Extending the Experience

- Return to the places periodically to renew a sense of belonging there.
- Encourage the children to find special places on their own and to visit them, care for them and learn about the plants, animals and the rest of nature there.
- Set up a spot where the children can display their journals, collections and illustrations of their places.

rest of the Earth by the things that we do? What can we do to take care of the Earth and keep the Earth strong and healthy for those children to come?

Activities

The Time of Our Lives



ACTIVITY: Walk a geologic time line to visualize the great age of the Earth and to discuss the immense impact people have had on the environment in the short time that we have walked the Earth. Discuss our ability to destroy the Earth with nuclear weapons.

GOALS: Visualize how short human history is relative to the Earth's geologic past. Understand what a powerful impact people have had on the Earth during the relatively short time that we have existed, and the potential destructive power of nuclear weapons.

AGE: Younger Children and Older Children

PROCEDURE: Mark along a trail, or in an open area, the distances shown in Figure 23-1 on page 190, which represent major events in the Earth's history. Do this by driving two sticks into the ground with a distance of 94 feet (28.7 meters) between them. Stretch the rope or string between these two sticks and tie it off at both ends, leaving the extra length of rope stretching beyond the stick that represents the present time. Drive the third stick into the ground about a few feet (one meter) beyond the "present time." Stretch the last length of rope up to this third stick and tie it off to represent time reaching into the future. Then tie the cloth strips onto the string or rope at the correct intervals.

As you walk this trail with the children, stop at each point and have children take turns reading the cards that describe the event marked at that spot. You may need to help young children with the reading. When you get near the end and are standing close to the point representing the present time, emphasize the brief amount of time people have been on the scene and yet how great the changes are that we have made in the world. As you stand at the place marking the present time, have the children look down the string pointing toward the future. Ask them what they think we will bring to future generations of people as a result of what we are now doing on the Earth. This point in the walk is a good time to mention that we now have enough physical power, through nuclear weapons, to undo the growth of our planet and all cultures in the span of minutes. And that despite this potential, even the smallest actions we take, when they are all added up, will have enormous impact on what happens to the

Earth and its inhabitants from now on.

The following activity, "Earth Circle of Life," should be conducted in the vicinity of the point marking the present time on this time trail. Explain to the children the connection between the past, our present actions (represented by the "Earth Circle of Life") and the future.

MATERIALS: Copy of Figure 23-1, hammer, string or rope 105 feet (32 meters) long, three 3-foot (.9-meter) sticks, eleven cloth strips for markers, long measuring tape, pictures for teaching aids, numbered index cards containing the information for each station along the time line.

Earth Circle of Life



ACTIVITY: (A) Stand in a circle to represent the Earth and the circles and cycles that are vital to sustain life. State the gifts given by each part of the Earth (sun, water, air, plants, etc.). (B) Thank the Earth for what it gives to us and promise to do something positive as a gift to life on Earth. Hold a ceremonial fire to symbolize the coming together of the gifts in the circle of giving and receiving between the Earth and people.

GOALS: Understand what each part of the Earth gives to people and other living things. Appreciate that people can thank the Earth, and that we can give back to it by taking care of it. Understand what we can do in our daily lives to be good stewards of the Earth.

AGE: Younger Children and Older Children

PROCEDURE: Beforehand: Make up the cards needed for the parts of the Earth for Procedure A, as described under "Materials."

PROCEDURE A: *Gifts from the Earth.* Bring all of the parts of the Earth together into a circle. Each small group of children, or individual child, will have a (some) card(s) with a symbol of a part of the Earth on one side (e.g. plants, water) and a brief statement of what that thing gives to people and other living things on the other side, as described in the "Materials" section. Explain that the circle of children symbolizes the Earth and the circles that keep life going: the nutrient cycle, life and death, and others described in the "Discussion" section of this chapter. Have the "sun" (a child carrying the yellow ball or other sun symbol) enter the center of the circle and tell what it gives to the people and other living things. The ball should be left in the center of the circle.

Now have each part of the Earth come into the center one at a time (that child or those children bearing the cards representing the parts of the Earth). The children will tell what each part of the Earth is and what

The Time of Our Lives (time line)

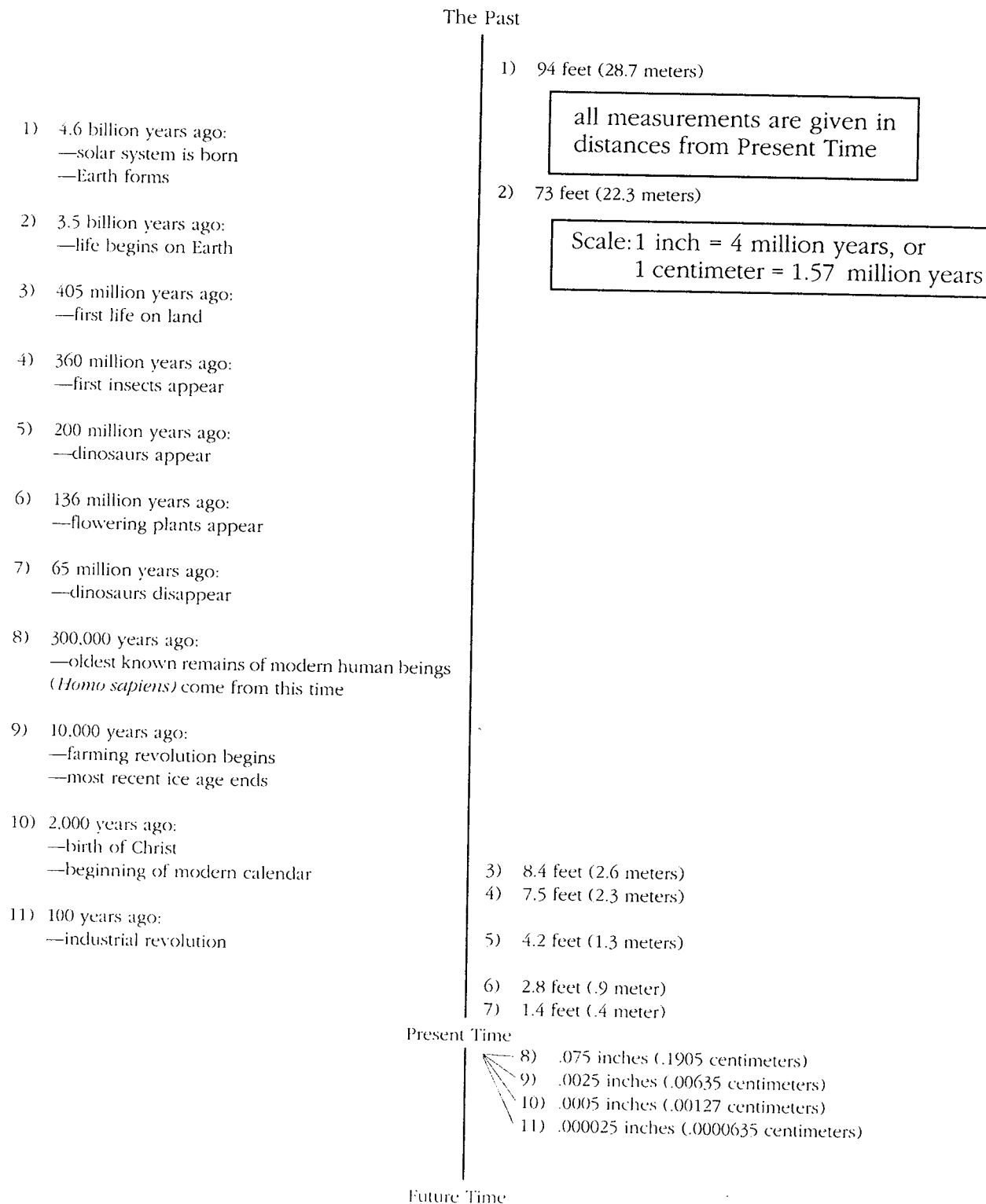


Figure 23-1

• 190 •
285

its gifts are to people and other life on Earth. The cards will be put in the center near the sun and left there, and the children will return to the edge of the circle. Each child or group of children representing a part of the Earth will repeat this procedure until all have done so and all of the cards are in the center.

PROCEDURE B: *Gifts to the Earth.* Have each child sit in place in the circle and write down on a piece of paper one or more things she/he promises to do to take care of the Earth—such as to conserve water, use less electricity to save energy, help an endangered species or recycle her/his solid waste instead of throwing it away. Many other ideas are suggested throughout the chapters of this book. Also on this paper, have each child express thanks for the gifts that the Earth gives to her or him by writing something such as a poem, short letter or a short story or by drawing a picture.

Now, one at a time, each child will come into the center of the circle to say what she or he promises to do to take care of the Earth and to share the way that she or he has thanked the Earth on the paper. Then the child will drop the slip of paper into the fire ring and return to the circle. When everyone has done this, burn the index cards and papers containing the gifts both to and from the Earth. Spread the ashes over the ground. These ashes symbolize the children's and Earth's gifts to each other, which complete the circle of life, of giving and receiving.

MATERIALS: (A) a yellow ball or other symbol of the sun; index cards representing parts of the Earth, with a picture on one side and a brief description of what that part gives to people and other living things on the other side. In large groups, some of these parts may be represented by several children. Or, in very small groups, each child may hold several index cards representing parts of the Earth. Here are some descriptions to include on these cards:

- sun—I(we) give light, heat and energy to make the plants grow. (The sun should be represented by a large yellow ball.)
- plants—I(we) use the sunlight and make food and oxygen for other living things.
- soil, rocks—I(we) feed the plants to make them grow (rocks, soil).
- air—I(we) give breath of life to the living things.
- water—I(we) quench the thirst and bring life to all plants and animals (rain, clouds, rivers, oceans, lakes, ponds and wetlands).
- seasons—I(we) — spring, summer, fall and winter — bring change each year: heat and cold, wet and dry, sleep and wakefulness, new life and old.
- animals—I(we) feed people and each other, help to

pollinate flowers and sow plant seeds, and bring movement and sounds to the Earth.

- stars and moon—I(we) light the night sky, guide way and (moon) bring the tides.
- people—I(we) care for the Earth and hold all parts of the Earth in our hands.
- stories—I(we) bring the world to life in your nation.
- life and death—I(we), life, bring living things where there were none before. I(we), death, make room for new life. We, life and death, keep the circle of life death turning.
- circles—I(we) keep the life on Earth going and keep everything in a good balance.

(B) Fire ring or container for burning papers in, match pencils, one piece of paper for each child on which she will promise one or more thing(s) she/he will do to care for the Earth and express thanks for the gifts the Earth gives to us, one cardboard backing for each child to support the paper as she or he writes.



Extending the Experience

- Design a puppet show depicting the major periods of geologic history. Use a narrator to describe the changes in life conditions on Earth through time. Create a dialogue for the plants, animals and humans as they appear in the course of Earth history.
- Rewrite the story of human history and how we have treated the environment through the present time. Focus on how people could have been better Earth stewards.

DWELLINGS IN A COMMUNITY

SUMMARY OF ACTIVITY

Students research different areas of California (or different cultures) and create a mural depicting traditional Native American dwellings or dwellings of other cultures.

Time: 20 minutes in class, one or two research periods, 30 to 45 minutes drawing mural

Setting: Classroom, school library

Materials:

- Reference materials for student research (see the resources section)
- Butcher paper or poster board
- Marking pens, crayons, or paint

Subjects: Social studies, art, language arts

Key Words: Community, dwellings, surroundings, natural materials, resources

RELATED CALIFORNIA FRAMEWORK CONCEPTS

People, their cultures, and the environments in which they live vary from place to place. (Adapted from *History-Social Science Framework*)

California's land and environment have changed from prehistoric times to the present. (Adapted from *History-Social Science Framework*)

Visual art media can be used to translate ideas, feelings, and values. (Adapted from *Visual and Performing Arts Framework*)

OBJECTIVE

After researching different geographic regions, students describe ways that dwellings suit their environment.

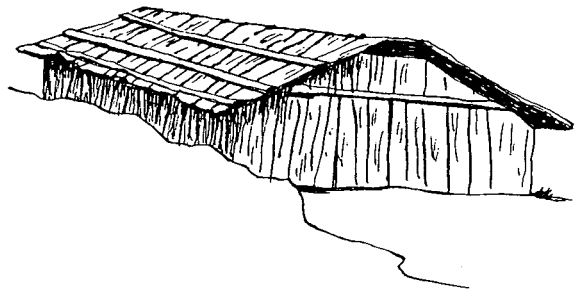
BACKGROUND INFORMATION

In the past, communities' needs were met entirely by the immediate environment. All food, water, and resources were gathered from the natural surroundings. Although this is still true to some extent in a few cultures of the world, most communities no longer depend solely on the immedi-

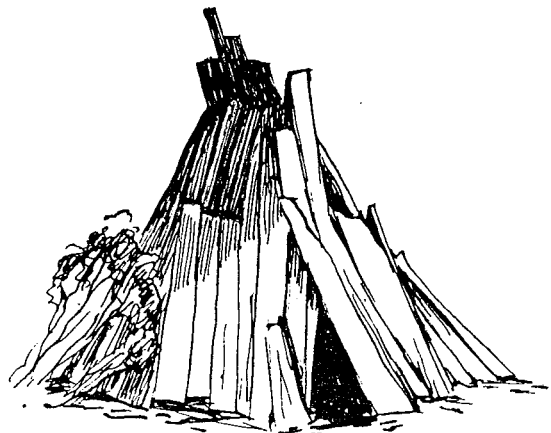
ate environment. Goods and resources from all over the world are now available in our communities.

At one time dwellings that people lived in varied greatly according to local conditions. The design of homes was determined by the natural building materials available and was suited to the climate in which the people lived. Native Americans living in different regions of California built houses that were particular to their region.

In the California Northwest, Native American houses were built from planks of cedar, pine, or fir trees logged from nearby forests. A pit was dug and the plank house was built over it. The strong, thick walls and roofs kept inhabitants cool in summer and warm in winter.

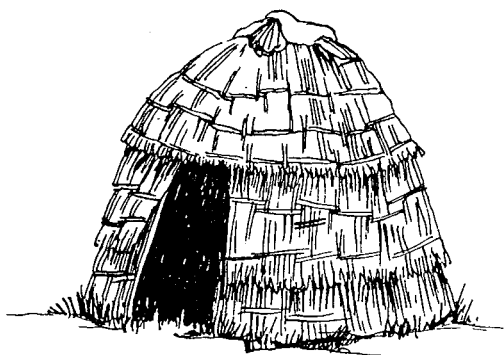


In mountain areas of California, thick slabs of bark from nearby redwood and cedar trees were piled against a central pole until no holes remained except a smoke hole in the top and a small doorway down below. During cold weather a door of tule or animal skin was used.



DWELLINGS IN A COMMUNITY (Continued)

Most homes built along the California coast were made of tule or brush. A pit about two feet deep was dug, then a frame of willow poles was made to curve over the pit. The frame was covered with brush or tules that were tied with cord made of nettles, milkweed, or hemp fiber.



Some Native American dwellings in the California Central Valley were earth-covered brush shelters. A pit was dug and lined with poles for the framework. The tips of the poles were tied together and brush and tule were laid on top of the framework. A layer of mud several inches thick covered the entire house. This design helped keep out summer's heat and winter's cold. Grasses and plants often grew on the earth-covered roofs so that the dwellings blended into the landscape.



In this activity students look at Native American dwellings in regions of California and find out how they relate to the environment. The activity can also be done by focusing on other cultures around the world. The term "culture" refers to the beliefs, social structure, and material traits of a group or community. The culture as well as the physical characteristics of a community are influenced by the natural environment.

PREPARATION AND LEAD-UP

Have reference materials available for student research or schedule library time for the research. Determine what areas of California students will study or whether they will study dwellings of other cultures around the world.

PROCEDURE

Day One

1. Ask students to relax and close their eyes. Take them on an excursion using guided imagery: "Imagine yourself where you were when you first woke up this morning . . . Put yourself in that place and tune into the sights, sounds, smells, feelings of where you were . . . Get up and begin your day, getting ready for school . . . Notice what running water, electricity, or other conveniences you use . . . Notice the different rooms you walk into and what those rooms are like . . . Pay attention to all your sensations . . . Imagine yourself starting off for school, traveling the way you usually do . . . Before you leave, take a good look at the outside of your home . . . Notice what it looks like, what the shape of the building is like, and what the building is made of . . . As you go to school, pay attention to smells, sounds, feelings, and sights . . . At some point along the way, where you feel comfortable, stop . . . Turn all the way around once, slowly . . . Now let the scene around you change . . . Let the buildings, the road, or sidewalk, the whole community seem to melt away to the way it may have been a long time ago . . . Imagine the day is just beginning once again . . . Imagine yourself now as a member of a Native American tribe (or other culture) who lived in the area at least 200 years ago . . . You are just waking up . . . Notice your surroundings, the sounds, smells, sights, and feelings that greet you . . . Get up and begin your morning activities, paying attention to where you are and what you use to do each thing . . . Notice what your home is like . . . When you are ready, bring yourself back to the present and open your eyes."

2. Invite students to share their experiences, being sensitive to the fact that many students prefer to keep quiet after a guided imagery journey. Tell students that they are going to find out more about

DWELLINGS IN A COMMUNITY (Continued)

Native American communities (or those of other cultures) and how they were affected by their natural surroundings.

3. Divide students into groups. Each group will research a different area of California like the California Northwest, California Mountain Region, California Coast, or the Central Valley (alternatively, have groups research different cultures around the world). Students will find out about the traditional Native American houses that were found in each area (or traditional houses in other cultures), answering questions like, "What natural materials were used to build the houses? Where did the materials come from? What happened to the houses when they were no longer lived in?" (See the discussion questions as well.) Allow students a couple of days to conduct their research.

Day Two

4. Have students use coloring pens, paints, or crayons to create a mural depicting traditional houses they have found out about. Each house should be placed in its appropriate terrain.

5. Discuss the appropriateness of materials used in the construction of the houses. Ask, "What was the climate in each area like? What materials were used to build the houses? Were these materials easy to find? How did the materials used for building the houses meet the shelter needs of the inhabitants?" Also discuss the communities students researched (see the discussion questions).

DISCUSSION QUESTIONS

How big were the communities?

How did the people in the communities have their needs met? Did they hunt? Grow their own food?

How might the natural surroundings have affected the communities?

How did the surroundings affect the houses you studied?

How do the surroundings affect our community?

Does the weather have any effect? Does the terrain (mountains, ocean, river, bay)?

EVALUATION

Repeat the guided imagery exercise. Ask students to write about how their mental picture changed

after studying more about the dwellings of Native Americans (or other culture they researched).

EXTENSION IDEAS

- Have students write a story on "A Day in the Life of a Kid from (the researched culture)." Alternatively, have students write a story that compares their own community with a community from the culture they researched.
- Have students draw pictures of houses they would like to live in that use some of the design features of Native American dwellings. Students can write or tell why they would like to live in the houses.

HOME LEARNING SUGGESTION

(Use as follow-up to this activity)

Challenge students to find ways that surroundings affect the design of their home or of buildings in the neighborhood. Give students a data sheet (see sample) and suggest they look for things like

Data Sheet for Home Learning

Features of my home that help keep it cool in summer:

Features of my home that help keep it warm in winter:

Other ways that the environment affects the design of my home:

DWELLINGS IN A COMMUNITY (Continued)

air conditioning, heating, covered patios, a swimming pool, trees for shade, and porches on the south (sunny) side of buildings.

RESOURCES

For Students

- Faber, Gail, and Michele Lasagna. *Whispers from the First Californians*. Alamo, Calif.: Magpie Publications, 1980. This book contains activities and information about Native Americans of California, including comparisons of various regions.
- Sauer, Carl. *Man in Nature*. Berkeley, Calif.: Turtle Island Foundation, 1975. This textbook is loaded with information about native people of North America and their ways of life.
- Siberell, Anne. *Houses: Shelters from Prehistoric Times to Today*. New York: Holt, Rinehart, and Winston, 1979. Siberell tells about how houses evolved through the ages, showing the development of more and more sophisticated

houses and how need, lifestyle, and available materials dictate the kinds of houses we live in.

Dunrea, Olivier. *Skara Brae: The Story of a Prehistoric Village*. New York: Holiday House, 1985. A village in the Orkney Islands (north of Scotland) is the setting for this story that tells how dwellings were built, furnished, and insulated, and how social and physical patterns of the community changed over generations.

SOURCE OF ACTIVITY

Project Learning Tree, "Another Way of Seeing."
Washington, DC.: The American Forest Council, 1977.

Illustrations adapted from:

- Elsasser, Albert B., and Robert F. Heizer. *The Natural World of the California Indians*. Berkeley: University of California Press, 1980.
- Faber, Gail, and Michele Lasagna. *Whispers from the First Californians*. Alamo, Calif.: Magpie Publications, 1980.

TOOLING AROUND

SUMMARY OF ACTIVITY

Students devise tools to solve different problems, then compare tools from another culture with contemporary tools.

Time: Three 30- to 45-minute periods plus research time

Setting: Classroom

Materials:

- Two or three tools or objects that might be used for tools (see the preparation and lead-up section)
- Drawing paper
- Drawing pens or crayons
- An assortment of contemporary tools

Subjects: Social studies, science, art, language arts

Key Words: Tools, culture

RELATED CALIFORNIA FRAMEWORK CONCEPTS

People, their cultures, and the environments in which they live vary from place to place. (Adapted from *History-Social Science Framework*)

The nature of society is strongly influenced by science and technology. (*Science Framework Addendum*)

Visual art media can be used to translate ideas, feelings, and values. (Adapted from *Visual and Performing Arts Framework*)

Writing enables us to communicate our ideas and can lead to a better understanding of ourselves and the human condition. (Adapted from *English-Language Arts Framework*)

OBJECTIVE

After creating tools to solve different problems, students compare another culture's tools with contemporary tools.

BACKGROUND INFORMATION

Human beings have a tremendous impact on the environment. Everywhere we look we can see

things made or arranged by humans. In cities, buildings and streets have been constructed, trees have been planted, and parks and open spaces have been landscaped to create effects we find pleasing. In the countryside, much of the land has been altered by generations of humans so that it looks much different than when people first ventured there.

It is only with the help of tools that we have been able to arrange the world to fit our needs. For thousands of years, people have been using tools to help them solve problems of daily living and to help make their lives easier. All cultures around the world have found ways of using tools. Traditionally, most of these tools came from the immediate environment, using materials like rocks, plants, and animal parts.

Tools from different cultures can look dissimilar even though they might perform the same tasks. For example, a nail that we use is much different from "nails" used by Northwest Coast Native Americans—they used strips of bark laced through holes drilled into the wood—but both types hold together two pieces of wood.

In this activity students are introduced to the idea that oftentimes there is more than one tool that can help solve a single problem. Although different tools may look strange to us at first, when studying them closely we can learn to appreciate that other cultures' tools often serve the same functions as our own. Usually the differences occur because people have learned to meet their needs using the resources available to them.

PREPARATION AND LEAD-UP

Gather two or three tools that students may not recognize like a cherry pitter, stud finder, or telephone cord retractor. Alternatively, find objects such as a stone, shells, or feathers that might be used as tools.

PROCEDURE

Day One

1. Show students the objects you have gathered (if you brought in unusual tools, don't tell students what they are). Divide students into groups of four and have them brainstorm a list of ways that each

TOOLING AROUND (Continued)

object could be used. Encourage students to be creative; for example, a stone might be used to pound nails, to keep a car from rolling away, to stop up the bathtub, to sharpen a pencil, to help warm up the bed (if the stone is heated), as a door stop, or as a step ladder.

2. Discuss with students the uses they have thought of for each object. If some of the objects are tools, demonstrate how they are used and what their purpose is.

3. Explain to students that a tool is something that helps you complete a job. Ask, "Can you think of tools you or people you know use?" List student suggestions on the board. Talk about how people who have different jobs must use different kinds of tools (for example, discuss the kinds of tools a carpenter and a plumber might use). Ask students how the tools are different and how they are alike (a carpenter might use a hammer, tape measure, saw, screwdriver, and a drill, while a plumber might use a pipe wrench, pliers, plunger, and a snake).

Day Two

4. Tell students that they are going to design tools for specific jobs. Give them a choice of several challenges such as the following:

- Design a tool that would make heavy objects easier to lift.
- Design a tool that would let you squeeze a slice of lemon without squirting the lemon juice in your eye or on your shirt.
- Design a tool that would enable you to put out candles without spattering wax and without making the wick smoke.
- Design a tool that would keep skeins of yarn or rope from getting tangled.
- Design a tool that would make pictures hang straight.
- Design a tool that would keep your shoes together in the closet.

Pass out paper and colored pens or crayons and have students work individually on the problem of their choice. Students are to draw a picture of the design they have created and write a paragraph

explaining how the tool they have designed would be used. Encourage students not to stop at one solution but to think of as many solutions as possible. When students have finished, have volunteers share their designs.

5. Discuss the fact that every culture throughout time has found ways of using tools to solve problems of daily living. Traditionally, most of these tools came from the community's immediate surroundings, and were made from materials like rocks, plants, and animal parts. The needs of people and the materials available to them vary around the world, so the ways people do things and the tools they have created also vary. With fourth grade students you might discuss the materials necessary for the tools they designed. Ask, "Are they materials that are available to our present culture? Were they available to Native American cultures of 200 years ago?"

6. Have students begin research of tools that Native Americans in your area used for building, preparing food, cooking, or making crafts. Have them draw pictures of tools. Alternatively, you might have students research and draw pictures of tools that were used by people of another culture you have studied.

Day Three

7. After the research has been done, bring in an assortment of contemporary tools and have students observe differences and similarities between these tools and tools used by Native Americans (or by people in another culture students have studied). Observations might include the function of tools (how jobs done by the tools are similar or different), the materials used, and how life would be different without the use of these tools.

8. Have students draw pictures of contemporary tools that perform tasks similar to tools used by Native Americans (or by people in another culture that students have studied). Discuss the uses.

DISCUSSION QUESTIONS

What materials were the tools made of?
How were the tools made?
How were they used?

TOOLING AROUND (Continued)

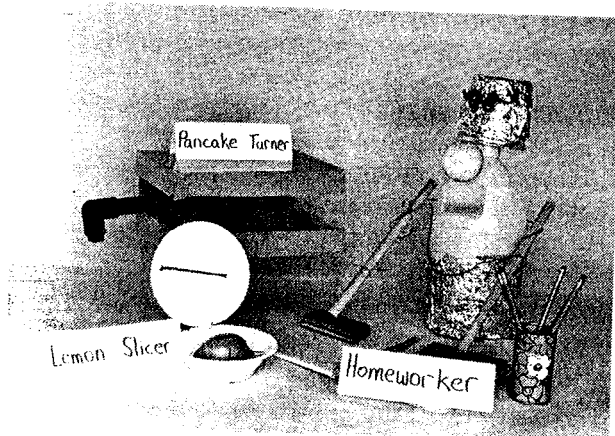
- How might the tools available to a community affect the community over time?
- Was there a special person in the community who made the tool?
- Was there a special person who used the tool?

EVALUATION

Have each student choose one tool from our culture and one tool from a Native American culture or another culture. For each tool, have students describe what the tool looks like, what the tool is made of, how to use the tool (step-by-step directions), and what problem or problems the tool solves.

EXTENSION IDEAS

- Have students re-examine their challenge problem and solution from the point of view of a Native American. Alternatively, design a challenge problem that is appropriate to the Native American lifestyle.
- Have students use "junk" materials to make models of the tools they designed. Stress to students that the tools must benefit society in some way.



- Have students study baskets made by Native American tribes in your area (check with historical societies, museums, or craft centers to see

about borrowing baskets). The class might study how the baskets were made, what tools were used to make them, if there were any people whose specific job was to make the baskets, and how the baskets were used (you might find a resource person in your area who could instruct students in making baskets). Discuss how the baskets compare to contemporary objects used for similar purposes.

- Have students study the different kinds of boats that Native Americans in California designed. Find out what materials were used, what tools were used, whose job it was to make the tools, and how the boats suited the lifestyle of the people that built them. Students might build models using materials similar to those used by Native Americans.
- Have students find out how animals use tools. *Animals That Use Tools*, by Barbara Ford, is a good source of information.

HOME LEARNING SUGGESTION

(Use as follow-up to this activity)

Have students ask parents to identify tools they use at work or home, and how they use them. Students can ask parents if the tool has changed over the years and, if so, how. Students then write a paragraph describing the tool and its uses.

RESOURCES

For Students

- Faber, Gail, and Michele Lasagna. *Whispers from the First Californians*. Alamo, Calif.: Magpie Publications, 1980. This book contains activities and information about Native Americans of California, including comparisons of various regions.
- Ford, Barbara. *Animals That Use Tools*. New York: Julian Messner Publishers, 1978. This children's book shows ways different animals use tools.
- Sauer, Carl. *Man in Nature*. Berkeley, Calif.: Turtle Island Foundation, 1975. This textbook is loaded with information about native people of North America and their ways of life.